THE JOURNAL OF GAS LIGHTING
WATER SUPPLY & SANITARY IMPROVEMENT

VOL. CIX. No. 2436.] LONDON, JANUARY 18, 1910. [62ND YEAR. PRICE 6d.

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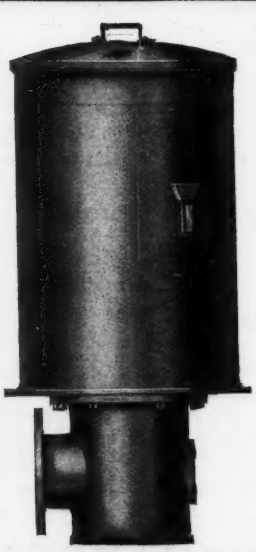

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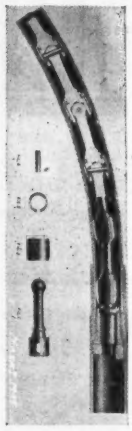

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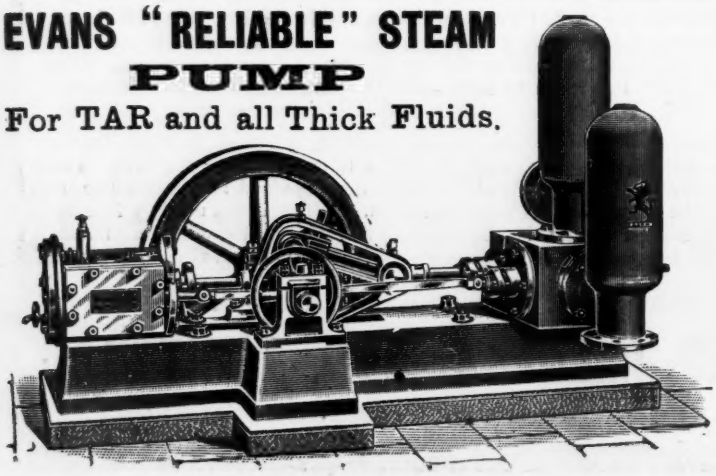

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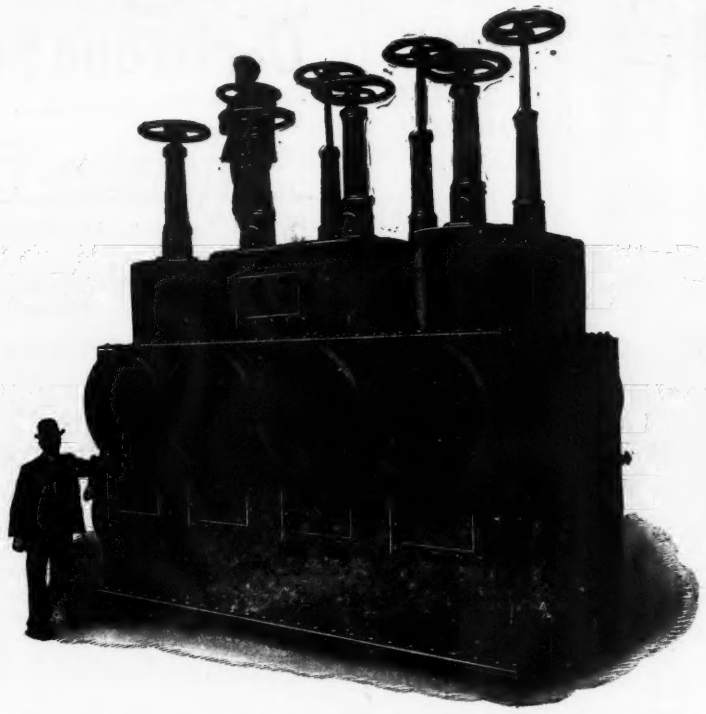

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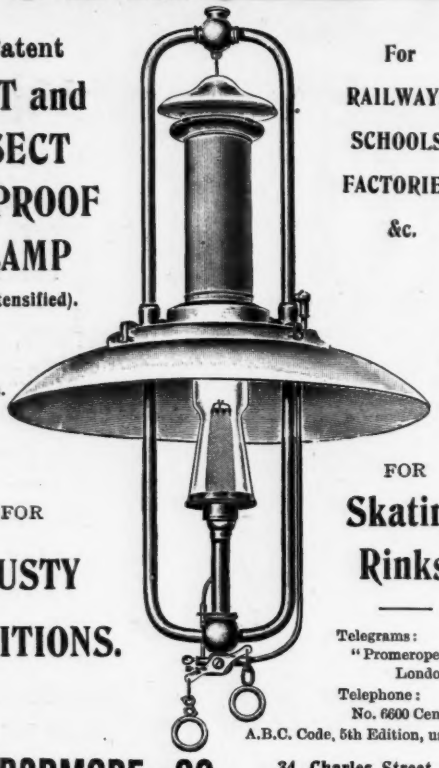

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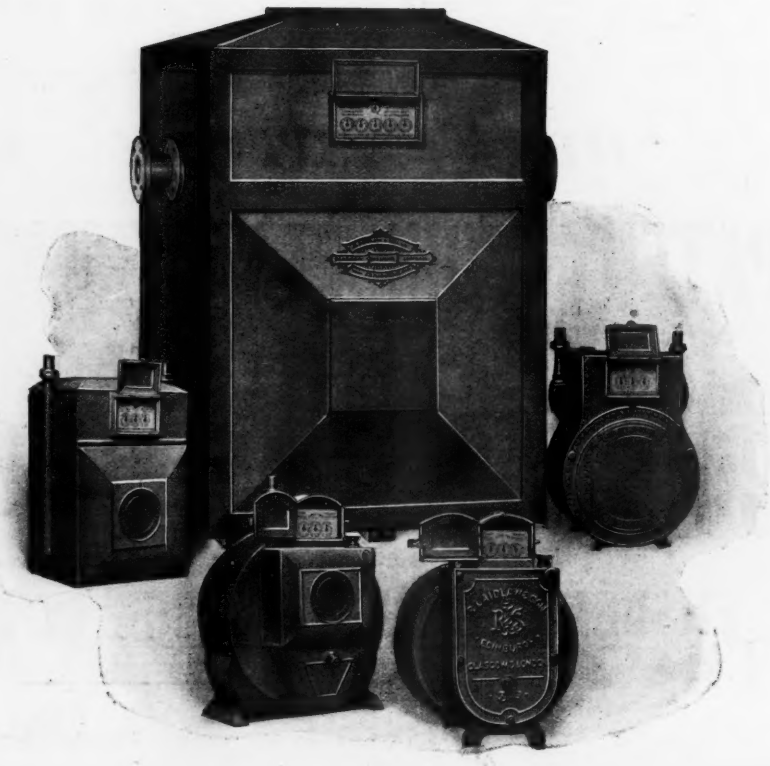

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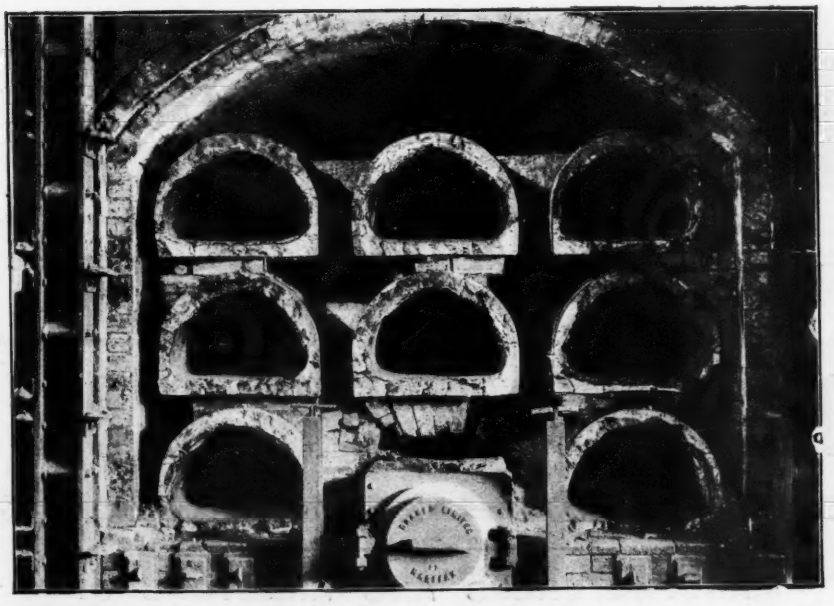

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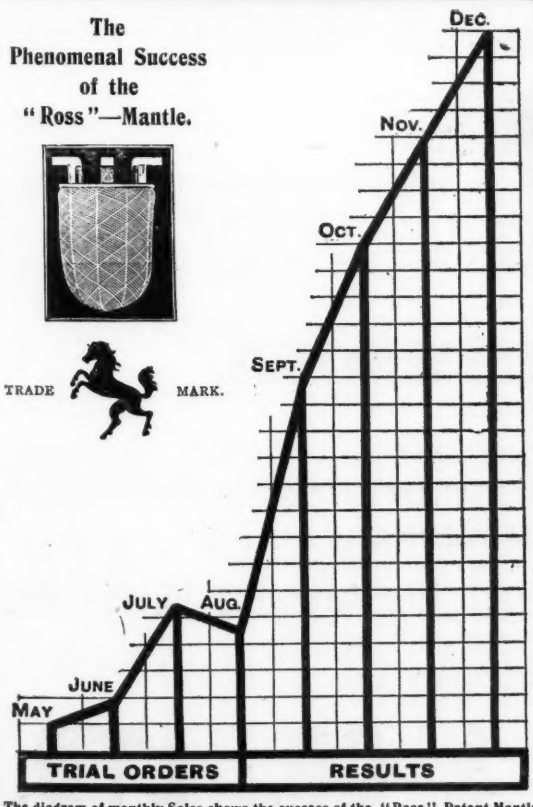

The diagram of monthly Sales shows the success of the "Ross" Patent Mantle since we first brought it to the notice of the British Gas Companies in May last. The curve speaks for itself.
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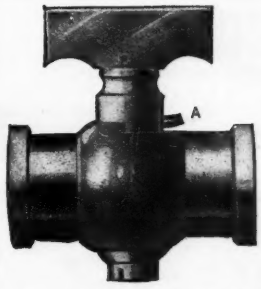

Fig. 1. The Old Style with the Old trouble. Note the Pin A.

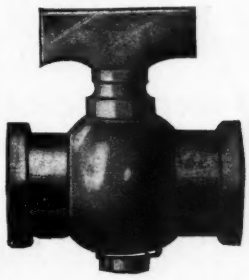

Fig. 2. **Evered's Patent "Safety Stop."** No Pin. No trouble.

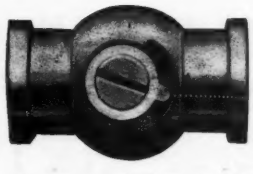

Fig. 3. Underside showing "Safety Stop in lieu of Pin.

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The projection shown in Fig. 3, marked **B,** working, in the recess shown in Block, allows the Tap to be turned only so far as the recess extends. There is no possibility of the Tap turning further round as there is no Pin to become displaced or broken.

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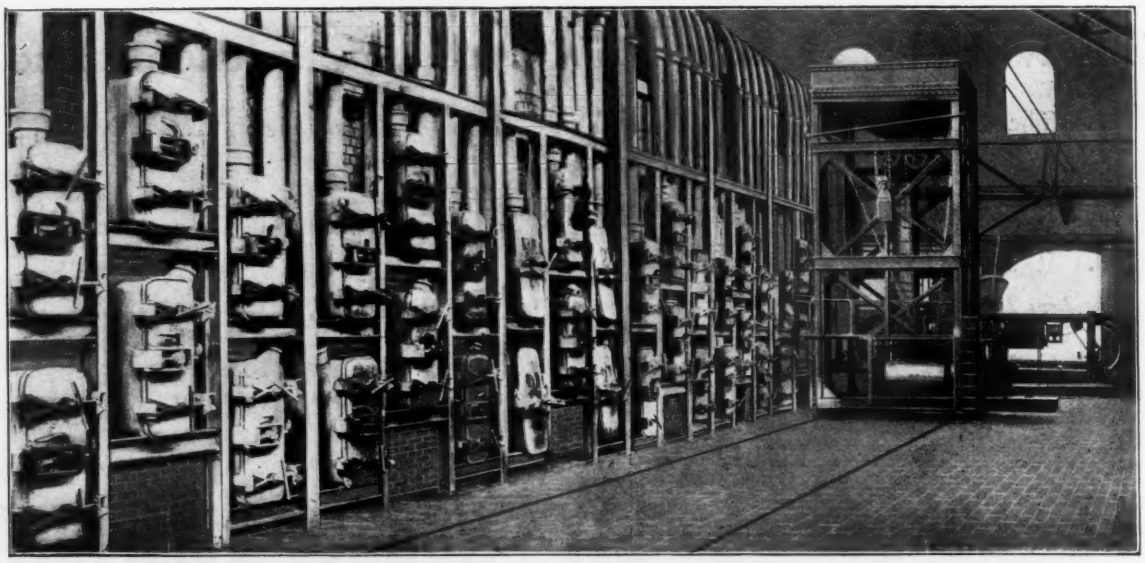

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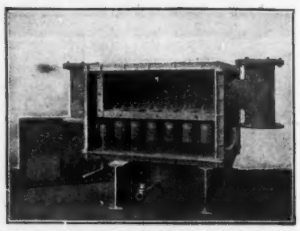

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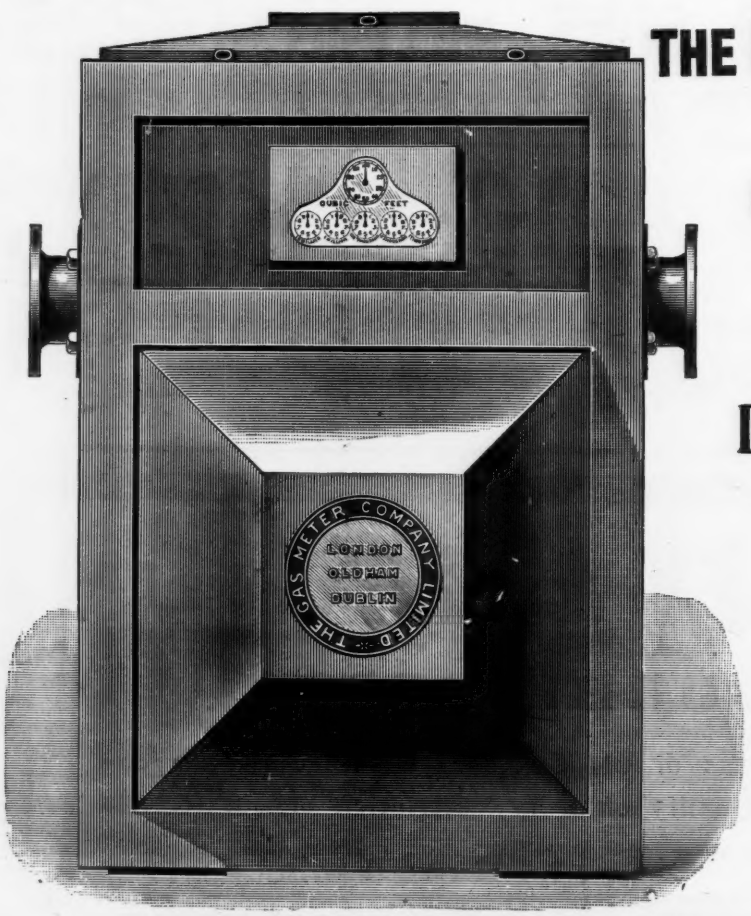

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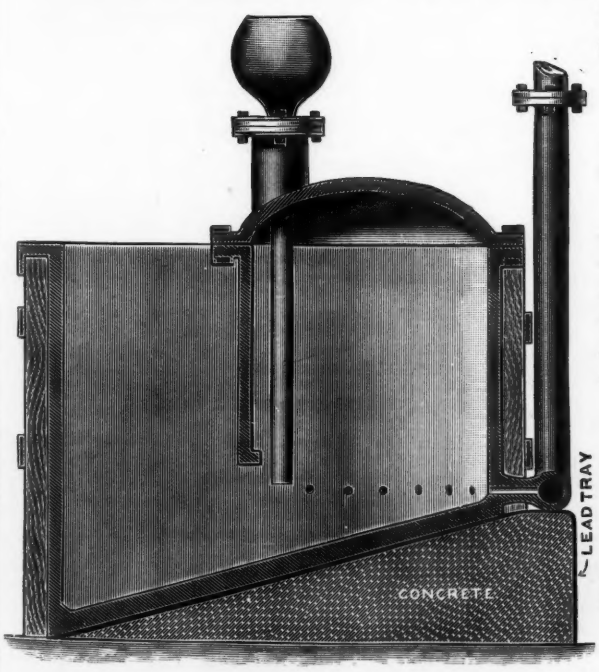

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Berlin—Charlottenburg	2,500,000	Gosport	200,000	Romford (2nd)	350,000
Berlin—Rixdorf	650,000	Göteborg, Sweden	300,000	Rotterdam, Holland	850,000
Berlin—Rixdorf (2nd)	700,000	Göteborg (2nd)	600,000	Rotterdam (2nd)	1,500,000
Berlin—Tegel	3,500,000	Graudenz, Prussia	200,000	Rotterdam (3rd)	750,000
Berlin—Tegel (2nd)	6,350,000	Guildford	350,000	Rotterdam (4th)	750,000
Bilston	375,000	Guildford (2nd)	200,000	Rotterdam (5th)	600,000
Birmingham	1,500,000	Haarlem, Holland	850,000	St. Albans	700,000
Bishop's Stortford	200,000	Hamburg, Germany	1,750,000	St. Gallen, Switz.	225,000
Bochum, Westphalia	530,000	Hampton Court	500,000	St. Gallen (2nd)	225,000
Bognor	100,000	Hampton Court (2nd)	600,000	St. Joseph, Mo.	750,000
Bordentown, N.J.	125,000	Hartlepool	750,000	San Paulo, Brazil	700,000
Bournemouth	1,000,000	Hebden Bridge	200,000	Santiago de Cuba	400,000
Bournemouth (2nd)	500,000	Heidelberg, Germany	200,000	Scarborough	800,000
Bremen, Germany	550,000	Holyoke, Mass.	600,000	Schwelm, Westphalia	100,000
Bremen (2nd)	950,000	Hong Kong	450,000	Shanghai	225,000
Bremen (3rd)	850,000	Hull	1,500,000	Shanghai (2nd)	225,000
Brentford	1,200,000	Ilford	650,000	Shanghai (3rd)	1,600,000
Brentford (2nd)	850,000	Innsbruck, Austria	200,000	Southampton	800,000
Bridgwater	200,000	Ipswich	750,000	Southampton (2nd)	500,000
Bridlington	150,000	Kampen, Holland	350,000	Southampton (3rd)	600,000
Bridlington (2nd)	200,000	Kiel, Sleswig	1,000,000	Southgate	400,000
Brieg, Silesia	100,000	Kiel (2nd)	880,000	Southport	750,000
Brighton	1,750,000	L. & N.W. Rly., Crewe	700,000	Southport (2nd)	900,000
Brighton (2nd)	1,850,000	Lausanne, Switz.	250,000	South Shields	650,000
Bromley	1,500,000	Lawrence, Mass.	400,000	Stafford	500,000
Bruges, Belgium	200,000	Lea Bridge	350,000	Staines	600,000
Brussels—Anderlecht	350,000	Lea Bridge (2nd)	350,000	Stettin, Germany	880,000
Brussels—Anderlecht (2nd)	350,000	Lea Bridge (3rd)	400,000	Stockholm	1,500,000
Brussels—Forest	1,000,000	Lea Bridge (4th)	1,000,000	Stockholm (2nd)	1,750,000
Brussels—Koekelberg	1,000,000	Leeuwarden, Holland	400,000	Stockport	600,000
Brussels—St. Gilles	1,000,000	Leiden, Holland	500,000	Stockport (2nd)	600,000
Brussels—St. Josse	1,000,000	Leiden (2nd)	575,000	Stockport (3rd)	400,000
Brussels—St. Josse (2nd)	600,000	Leigh, Lancs.	350,000	Stockton-on-Tees	500,000
Brussels—Ville	750,000	Lemberg, Galicia	260,000	Swansea	750,000
Brussels—Ville (2nd)	750,000	Lemberg (2nd)	500,000	Swansea (2nd)	1,000,000
Brussels—Ville (3rd)	1,500,000	Liége, Belgium	1,000,000	Swansea (3rd)	450,000
Brussels—Ville (4th)	350,000	Liége (2nd)	750,000	Swindon	300,000
Bucarest, Roumania	1,100,000	Lincoln	500,000	Sydney—Harbour	500,000
Budapest, Hungary	50,000	Liverpool	3,500,000	Sydney—Harbour (2nd)	500,000
Budapest (2nd)	1,750,000	Liverpool (2nd)	4,500,000	Sydney—Mortlake	500,000
Carlisle	600,000	Longton	600,000	Sydney—Mortlake (2nd)	500,000
Carlsruhe, Germany	500,000	Louvain, Belgium	800,000	Syracuse, N.Y.	850,000
Chigwell	350,000	Lübeck, Germany	400,000	Taunton	225,000
Chorley	300,000	Maastricht, Holland	200,000	Taunton (2nd)	350,000
Commercial, London	850,000	Magdeburg, Germany	1,400,000	The Hague Holland	1,000,000
Commercial (2nd)	850,000	Maidenhead	225,000	The Hague (2nd)	500,000
Commercial (3rd)	1,250,000	Maidenhead (2nd)	225,000	Tilburg, Holland	400,000
Commercial (4th)	2,000,000	Maidstone	500,000	Torquay	350,000
Copenhagen	700,000	Malines, Belgium	500,000	Tottenham	750,000
Copenhagen (2nd)	2,500,000	Malmö, Sweden	350,000	Tottenham (2nd)	750,000
Courtrai, Belgium	250,000	Malta	400,000	Tottenham (3rd)	350,000
Coventry	600,000	Manchester	3,500,000	Tottenham (4th)	1,000,000
Coventry (2nd)	600,000	Manchester (2nd)	3,500,000	Tottenham (5th)	1,000,000
Cracow, Galicia	200,000	Marlborough	100,000	Tottenham (6th)	1,250,000
Cracow (2nd)	200,000	Mayence, Germany	700,000	Tunbridge Wells	1,000,000
Crefeld, Germany	500,000	McKeesport, Pa.	500,000	Utrecht, Holland	1,000,000
Croydon	1,250,000	Merthyr Tydfil	300,000	Utrecht (2nd)	1,000,000
Croydon (2nd)	625,000	Middlesbrough	1,250,000	Verviers, Belgium	1,000,000
Croydon (3rd)	625,000	Namur, Belgium	175,000	Vienna	3,500,000
Croydon (4th)	550,000	Nelson	400,000	Vienna (2nd)	2,500,000
Debreczin, Hungary	100,000	Newburgh, N.Y.	600,000	Waltham	400,000
Deventer, Holland	150,000	New York	5,200,000	Wandsworth & Putney	1,800,000
Deventer (2nd)	200,000	Nictheroy, Brazil	250,000	Watford	300,000
Dorking	150,000	North Middlesex	150,000	Watford (2nd)	350,000
Dublin	2,000,000	North Middlesex (2nd)	200,000	Wellington, N.Z.	350,000
Dublin (2nd)	2,000,000	North Middlesex (3rd)	75,000	West Bromwich	550,000
Dublin (3rd)	650,000	Norwich	1,000,000	West Ham	1,500,000
Dundee	1,500,000	Norwich (2nd)	300,000	West Ham (2nd)	800,000
Dunedin, N.Z.	150,000	Norwich (3rd)	500,000	Weston-super-Mare	350,000
Dunedin, N.Z. (2nd)	275,000	Nottingham	1,000,000	Weston (2nd)	350,000
Durham	200,000	Nottingham (2nd)	1,000,000	Wexford, Ireland	100,000
Düsseldorf, Germany	1,000,000	Nuneaton	125,000	Wiesbaden, Germany	850,000
Eastbourne	1,250,000	Oberhausen, Germany	175,000	Winchester	225,000
Edinburgh	2,000,000	Oldenburg, Germany	200,000	Winchester (2nd)	125,000
Epsom	225,000	Ostend, Belgium	100,000	Wolverhampton	1,500,000
Epsom (2nd)	300,000	Ostend (2nd)	200,000	Zwolle, Holland	200,000
Falmouth	150,000	Perth, W.A.	125,000	Zwolle (2nd)	200,000

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EDITORIAL NOTES—GAS, &c.

The Sunderland Verticals at Work.

THE Dessau 4-metre vertical retort installation at Sunderland has now been at work some five weeks; but the greater part of the time has been spent by the Engineer (Mr. Charles Dru Drury) in experimenting with the plant in different ways, with and without steaming, in order to satisfy himself as to the best method of operation to meet his particular requirements. But in the midst of the experiments, an opportunity has been taken to put the installation through its guarantee test; and we have pleasure in publishing the results in another column. The guarantees have been in every respect fulfilled, without need for qualification in any particular. Therefore, there may be complete congratulation to both Mr. Drury and the Contractors (the Dessau Vertical Retort Company) on the success achieved at this the initial stage. Over figures with Mr. Drury's signature attached, there can be no captious disputation. No doubt from the Vertical Retort Syndicate's point of view, an important feature is that the results effectually lay the bogey which has been raised in so many quarters in regard to the illuminating power of the gas produced by Dessau retorts. It is somewhat strange, after the numerous well-attested figures that have been published, that there should have been any doubt whatsoever on the subject. But it will be readily seen from the Sunderland trial results that, had the object not been to obtain gas of a fairly high illuminating power, a much larger yield per ton might have been realized. The coal carbonized was Holmside (Durham); and the quantity used in the trial was 124·11 tons. The production per ton (without steaming) was 12,028 cubic feet, of an illuminating power of 17·55 candles, tested by the "Metropolitan" No. 2 burner. The calorific value was good—635·4 B.Th.U. gross, and 568 9 B.Th.U. net. These figures are highly satisfactory, and show that, under a lower quality requirement, there is abundant room for stretching the make beyond the 12,028 cubic feet realized under present conditions. In fact, those interested in the system see no reason—using coal of the quality of that employed at Sunderland—why a production should not be realized of considerably over 14,000 cubic feet of 14·5-candle gas, with a calorific value of about 500 B.Th.U. net.

Glare.

THE multifarious definitions of glare offered by Dr. J. Herbert Parsons, F.R.C.S., and his brother physiologists at the meeting of the Illuminating Engineering Society last Tuesday were such admitted and conspicuous failures that we may perhaps be pardoned for not presenting to readers of the "JOURNAL" an exact definition of the meaning of the word. Nevertheless, the impression of glare is certainly susceptible of interpretation in a manner comprehensible to persons not trained in the ways of thought of the physiologist; and we may therefore indicate broadly what are its distinguishing factors. In the first place, however, it may be pointed out that it was ignored by many speakers at the meeting, and insufficiently emphasized by the rest, that the impression of glare is essentially one of relative brightness or of contrast between lights of widely different intensity. An electric arc lamp or an acetylene flare light, if in the line of vision after dusk, certainly conveys the impression of glare; but the same lights may be viewed in the open on a bright sunny day, and they will appear relatively dull and the impression of glare will be minimized if not wholly eliminated. On the other hand, a feeble electric glow lamp, such as those which, by "terminological inexactitude," the electricians are wont to describe as of 16-candle power, will, if it confronts one suddenly in the country on a dark night, undoubtedly convey the impression of glare. It is mainly, if not wholly, a question of contrast between the light to which the eyes for the time being have become accustomed, and the stronger light of the object from which the so-called glare emanates. The contention that glare is chiefly a relative or contrast effect is supported by the fact that it is most noticeable with lights of varying intensity. Thus the impression of glare is more pronounced with an electric arc lamp which flickers violently from time to time, or with an acetylene head-lamp on a car proceeding rapidly along an uneven road, than with incandescent gas-lamps of equal intensity, or with the same head-lamp when the car is at rest. In those cases, part, though not the whole, of the phenomenon of glare is due to the eye receiving a light much stronger than that with which it had become familiarized a few moments earlier.

That glare is not a question of sheer intensity of the light is evident from the fact that the effect of glare is common in cases of artificial illumination where the illumination is considerably lower than that of full daylight, although with the latter the sense of glare is generally absent. In full daylight, however, the source of light is well overhead; and it is only by direct intention that, in the ordinary pursuits of life, the individual gazes at the sun. In his general avocations of walking and working abroad in daylight, a man's eyes are directed towards the ground or occasionally towards the horizon; and it is only when the surface of the ground is of such a character that the sunlight is strongly reflected from it, that he is troubled with glare. In this country glare out-of-doors is only experienced on a white and dusty road or the shining surface of smooth water or wet asphalte. The phenomenon of snow blindness is not a pure case of glare, and need not be discussed. In so far as artificial illumination reproduces as exactly as may be the illumination afforded by sunlight, glare will, generally speaking, be absent; but regard must be paid to the work or pursuits of the individual at the time. In the artificial conditions of existence, which the necessity of spending many hours of the day and night indoors has called forth, we have become accustomed to the use of floor and wall coverings, drapery, books, and the general *bric-à-brac* of a room, all contributing to a more subdued illumination than that afforded by direct sunlight. Nothing is more trying in respect of glare than the reading of a book fully lighted by the mid-day sun; and anyone who wishes to read continuously out-of-doors on a bright summer day, takes care to screen the printed page from the direct sunlight. Otherwise, the glare from the illuminated surface would prove a cause of serious discomfort and even pain. Indoors, too, we are in the habit of curtailing the daylight illumination from our windows by the use of blinds and curtains; and with the thus curtailed illumination, we go about our ordinary home or office pursuits in comfort, and with an absence of any impression of glare.

Artificial illumination of an interior should aim at producing the general intensity and uniformity of lighting that is afforded by daylight as thus transmitted through windows and curtains. This aim is best fulfilled by the indirect illumination from a ceiling which is lighted directly and by reflection from artificial sources screened on their lower side. Such indirect illumination, if adequate, is relatively costly; and it is not every room or interior which is adapted for its application. The next best form of artificial illumination is direct lighting by inverted gas-burners suspended at a sufficient height from the floor to be above the ordinary line of vision of the occupants of a room. In rooms up to a size of 20 feet square, a height of 7 feet from the floor fulfils this condition; but for larger interiors, where the lights may be viewed from a greater distance, a higher elevation of the lights is desirable. The uniform distribution and the steadiness of the light from modern inverted gas-burners give them a superiority over electric lamps quite apart from the immensely higher cost of maintenance of the latter. Adequate illumination of a room 25 feet by 15 feet may be secured by the use of three inverted gas-burners each of about 100-candle power; and, provided they are suspended at a height of not less than 7½ feet from the floor, the users of the room will not be troubled with the effects of glare. Such illumination will suffice for reading in any part of the room, and objects on the floor and walls will be well lighted.

On the other hand, if reading is pursued in the same room by the help only of the typical table reading-stand fitted with an ordinary electric glow lamp, the impression of glare will be obtained from the printed page whenever the eyes are directed on the latter after gazing for a moment or two at the gloom in which the rest of the room is enshrouded. The intensity of the effect of glare will, of course, depend on the surfacing of the paper of the book. With most modern highly faced printing papers, the effect of glare in the latter conditions is very marked; but, if the eyes have become accustomed to approximately the same degree of illumination of all the surrounding objects, glare from the surface of the paper will scarcely be remarked. For the reasons indicated, it is evident that, as anyone who doubts may easily prove for himself, the impression of glare with its troublesome effects is much more easily to be obtained by the adoption of the methods of illumination which are more commonly followed in installations of electric lighting than in those of gas lighting.

To sum up, glare is palpably an effect produced mainly by the contrast of light, whether direct or reflected, from different sources or objects of widely divergent relative intensity. This prosaic view of the question of glare is likely to be fruitful of more good effects if properly regarded by illuminating engineers and the public than the disquisitions of the learned physiologists and medical men who essayed to discuss it at last Tuesday's meeting. Stripped of all the jargon of the physiologist and anatomist, there is little left of real value in what was said at the meeting. The Illuminating Engineering Society will do well in future not to confine the treatment of a subject at any of their meetings to the one-sided views of one section of scientific men, however able the representatives of that section may be in their own branches of research. Otherwise, the general body of practical technical men will cease to take interest in its proceedings.

Tar-Painted Roads and Farm Stock.

THE judgment given in the Ashford (Kent) County Court on the 10th inst., and which is reported on another page of to-day's "JOURNAL," in a case by which a firm of farmers at Charing obtained damages for the loss of a cow which the Judge decided had been poisoned by swallowing tar, or water containing tar, coming from a road which had been painted with tar by the Kent County Council, deserves notice, in view of the fact that, if allowed to stand, it may tend to hinder the authorities responsible for the maintenance of roads in different parts of the country from using tar as a means of keeping in repair the main roads under their charge.

The farmers alleged that the cow, which was one of a number grazing in a field adjoining the main road, had been poisoned through drinking from a ditch or pool in the field, into either of which it was possible that rain washings from the tarred road might gain access. In support of their contention that this cow alone of the whole herd had been poisoned by tar washings from the road, the farmers called a veterinary surgeon who had made a postmortem examination on the animal and Professor Lander, D.Sc., of the Royal Veterinary College, who had made an analysis of a portion of the viscera. In cross-examination, both of these witnesses stated that they had no direct evidence of poisoning by coal tar, except the fact that a large quantity of phenols (carbolic acid and its homologues) had been found in the viscera. Other constituents of coal tar, such as pitch and sulphocyanide, were not observed or detected by them. By what we cannot but regard as an unfortunate departure from scientific terminology, these witnesses spoke of the phenols as "tar-acids"—an expression that might well convey to the Court the impression that the poison must necessarily have been derived directly from tar. They admitted that they had no more than a general knowledge of the character and composition of tar, and did not impugn the good quality or the fitness for its purpose of the particular tar used. The defendants, the Kent County Council, did not dispute the plaintiffs' evidence that the cow had really died from phenol poisoning; but they contended that the phenols must have been taken in a more concentrated state than that in which they exist in tar or tar washings, and suggested that a tank of creosote on another part of plaintiffs' farm was a possible source of the poison taken by the cow. Mr. H. P. Maybury, the Surveyor of the Kent County Council (who, as readers will remember, was formerly in charge of the Malvern Gas-Works), stated that no cases of poisoning of cattle by washings from tarred roads had come to his knowledge, though there were now 500 miles of tarred roads in Kent; and he knew of a pool which was supplied solely by the surface washings from such a road, from which cattle drank freely without suffering injury. Mr. W. J. A. Butterfield gave evidence to the effect that the amount of phenols found by Dr. Lander in the viscera implied the consumption by the cow of several gallons of the tar itself or several hundred gallons of water which had been in contact with tar. He also laid stress on the fact that there was no evidence of the animal having been in contact with tar or of other constituents of tar having been found in its stomach. Nevertheless, the County Court Judge decided that the plaintiffs' cow had died through swallowing tar, or water containing tar, and that the tar had come from the road. In regard to the latter point, it must be remembered that the tar had been on the road for several days before rain fell, and that the layer, which had in the first instance been very thin and had been covered with sand, had become thoroughly incorporated with the road surface before the rain fell. It is difficult to reconcile the Judge's finding with these facts; and it is to be hoped that the County Council will obtain redress on the appeal which they have still time to enter.

Other points of interest in the judgment are that the County Court Judge regarded it as proved that the tarring of roads was a proper and efficient method of repairing them, and more economical than the use of granite without tar. But he found that it was not absolutely necessary to repair the road with tar; and hence he held the County Council liable for the consequences of its use therefor. It had not been contended by the plaintiffs that there had been negligence in the application of the tar. The judgment, as it stands, is extremely unsatisfactory from the point of view of all interested in the use of tar for road maintenance. Unless it is reversed on appeal, it will undoubtedly prove a check on the employment of tar for road repair and maintenance; and all classes of the community using country roads will suffer accordingly. Moreover, so far as we can judge from the reports to hand, it rests on such an unsatisfactory basis in respect of the facts, that it should not be difficult to secure its reversal, if the Kent County Council can see their way to carry the case to appeal.

Sulphate of Ammonia.

HELPFUL, as usual, is the annual review by Messrs. Bradbury and Hirsch of the sulphate of ammonia market during 1909. There may be some question in a few minds as to the value of a market retrospect of the kind, seeing that the year has been passed through, and, for good or ill, the financial results for producers have been shaped, and are unalterable. A review of this kind, however, by a firm occupying a special position for making observation, whose business it is to note tendencies as well as actualities, enables one to form a fair idea of the drift of things, and as to where to look for developments that may materially influence the future. The present review is replete with suggestiveness; and there is much in it that urges the importance of home producers pushing forward at this period, in no uncertain manner, in the endeavour to fully maintain their position in the fertilizer trade both at home and abroad. Competition is growing more and more acute; and this is inevitable with production increasing at a substantial rate. Except for a rise of a few shillings at the end of March, the price of sulphate of ammonia during the year did not vary much—the difference between the close and the beginning being only about 2s. 6d. per ton, with the price at the end at £11 7s. 6d. As to export business, the year terminated better than the conditions at the opening allowed one to hope would be the case. There were the lower prices of nitrate of soda, the falling off of the Japanese demand, the diminishing requirements of the Continent owing to its own increasing production, and the knowledge regarding the augmented activity of Germany in competing for distant demand. But, in the result, while exports to the Continent fell away by about 8000 tons, compared with 1908, in all other directions shipments from this country increased. Japan provided the one sensational feature of the year, by, in the second half, moving from sluggish to vigorous purchasing conditions, and ending the year with an excess shipment compared with 1908 of between 10,000 and 11,000 tons. With the increases in other directions, the export business showed a gain of close upon 30,000 tons.

After carefully reading through the review, one puts it

down strongly impressed as to the need in this market for keeping an eye on Germany. Production is increasing in that country, Belgium, and France; but it is from Germany that competition will be the keenest for oversea business. From stated premises, Messrs. Bradbury and Hirsch make this deduction: "In Germany, where the sulphate of "ammonia propaganda is still being vigorously pushed, "we think that more and not less sulphate of ammonia will "be used; but from the reservation of their own market "in recent months, and in offering more freely in foreign "markets than they did a year ago, it is fair to infer that "German producers are of opinion that their output has "increased more rapidly than their home consumption is "likely to increase." That is then one direction from which an accentuated competition may be looked for. But our own increase in production will not allow ground to be cut from under our feet by the commercial acumen of competitors abroad. Last year's home production in all directions exhibits an augmentation compared with 1908—the estimated total increase being 26,500 tons, which was more than absorbed by additional export trade. This extra output is divided between gas-works, 6000 tons; iron-works, 1000 tons; shale-works, 3500 tons; and coke and carbonizing works, 16,000 tons. This indicates the source of largest augmentation in future; and the last-named figure also materially lessens the margin between gas-works and coke-oven productions. Only as recently as 1904, the latter source of production was 116,500 tons behind gas undertakings; but by the end of last year, its yield had caused a contraction of the difference to 70,000 tons. In view of the industrial position in the country, there is no prospect of any great access of production from gas undertakings.

The position then is this: Production is increasing. So far, we have done very well in, either at home or abroad, absorbing the increase. But owing to enlarged and still enlarging production in neighbouring countries, the Continent is a declining market; while the increasing production there and at home forces the pace of competition for demand further abroad. In addition to this, the conditions and prospects are considered good for the nitrate of soda market in respect of volume of business. All this points to the need of a vigorous policy in connection with sulphate of ammonia, not less in regard to the export trade than in respect of the home market. The work required at home is educational; and we are glad to see that the Sulphate of Ammonia Committee are leavening their past propaganda with new schemes. It passes understanding why among users there should still be, with all that has been done, the want of appreciation as to the substantial difference there is in the market value of the unit of nitrogen in sulphate of ammonia and nitrate of soda. That value is even now something like 9d. less for sulphate of ammonia than for nitrate of soda. This marks the cheaper article in point of intrinsic value; but it requires a great deal of perseverance to drive the fact home among agriculturists who, owing to custom or other cause, have not yet pinned their faith to sulphate of ammonia.

Gas Legislation.

Among the Gas Bills reviewed this week will be found that of the Brighton and Hove Gas Company; and one of the objects in view, it will be remarked, is the formation of a capital redemption fund. A fortnight since, attention was called to the Bishop's Stortford instance. In the Brighton case, it is intended to form the fund by half-yearly appropriations from revenue not exceeding ¼ per cent. on the paid-up capital; but the section is not to operate in respect of any half year immediately succeeding any period of twelve months ending in June or December during which the gas sold by the Company has exceeded the rate of 1 million cubic feet for each £500 of paid-up capital. In the Bishop's Stortford case, the proposal is half-yearly appropriations at a rate not exceeding ¼ per cent.; and the limit of operation is £400, instead of £500. The Company are also dealing with the question of illuminating power and testing. And so are the Bristol Company in their many-featured Bill. Among other matters, the latter are taking power to obtain better supervision over consumers' fittings in connection with escapes, and fittings in unoccupied houses. A clause giving the Company protection in the matter of stand-by supplies is included, as is also one abolishing penalty testing in connection with sulphur compounds other than sulphuretted hydrogen. Coming events sometimes cast their shadows before; and in the Bill, it is noticed, the Directors are proposing to take power to appoint from among themselves a Managing-Director. We feel sorry the Ammanford Gas Company have occasion, after last year's Act, to appear in Parliament this coming session. But some grades of mud have a nasty way of sticking tight; and part of that collected by the Amman Valley Company is tenaciously adhering to the new Ammanford Company. They have a difficulty, in consequence, in issuing capital upon reasonable terms; and they have also trouble in getting satisfactory information as to the issue of certain debentures by the old Company. The Bill that is being promoted is intended to help the Company in both respects.

The Volume of Increase.

In the "JOURNAL" last week, extracts were given from the paper recently read by Dr. W. B. Davidson before the Birmingham Section of the Society of Chemical Industry. The author commented on the notable increase in the output of gas that took place during the eighties and nineties. "Naturally," he remarked, "this extraordinary development could not be maintained for very many years; and so it is not surprising that the last decade has witnessed a considerable slackening in the demand for town gas." This is rather a sweeping assertion. He illustrates the point by giving the outputs of 24 of the largest gas undertakings in the United Kingdom for 1888, 1898, and 1908, together with the decennial percentage increments for the two intervals. The decennial average percentage increases are shown to be 40·8 for 1888-1898 and 28 for 1898-1908. These percentages do not correctly show the relation of the increase in the two periods. And the volumes of gas sold—51,677 millions in 1888, 72,786 millions in 1898, and 93,179 millions in 1908—hardly justify the expression "considerable slackening in the demand;" seeing that in the first decade the increase was 21,109 millions, and in the second decade 20,393 millions—a decrease of only 716 millions in the volume of increase in ten years spread over 24 large undertakings.

Electricity and Fires.

Electricity this Christmas and New Year's time is earning for itself a very bad name; and the electrical press find the facts too hard for them to deny. Damage by fire to the estimated amount of £100,000 was done last Thursday at the drapery and furnishing stores of Messrs. D. D. Evans and Co., of High Road, Kilburn; and there appears no loophole for escape from the charge that it was due to electrical fusion or the explosion of an electric lamp. The facts are simple. The shops were closed for the day; but the manager decided upon an evening display of the shop windows. He went to the basement of the underclothing department, and switched on the current. No one, it appears, was in the window at the time; in fact, there were no assistants at all in the part of the shop where the fire broke out. Before the manager knew what had happened, the whole window was ablaze; and the flames were rushing through the other shops with remarkable rapidity. In all, five shops were involved in the conflagration. The head of the firm states that the electric light installation was of the most up-to-date kind. And so was the installation at Messrs. Arding and Hobbs's. Fortunately, there was no loss of life in the Kilburn catastrophe; but the destruction of property, as stated, was enormous. There must to-day be a great many uneasy heads of firms whose premises are electrically lighted, and contain valuable stocks of goods. They may be insured; but the insurance does not cover the losses caused by the interruption of the ordinary course of business.

A Denial.

Since the above was written, Mr. G. H. Cottam, Chief Engineer of the Hampstead Electricity Department, has sent a letter to the papers denying that the fire was due to electricity. His denial is not based on personal knowledge; but he asserts that he "can produce several witnesses, among whom is the man who rang the fire alarm, and who noticed the fire at one of the first-floor windows, on which floor electric light is not installed. In fact, the interior of the building where the fire originated is lit with gas." The man who rang the fire alarm does not appear to have been on the premises; but the manager of Messrs. Evans and Co. was. The window that first blew out was electrically lighted; and as flames have a natural habit of ascending, we should not be surprised to learn that, when noticed outside the premises, they had

found means of exposing themselves at the first-floor windows. Mr. Cottam's evidence will have to be very strong to upset the original version of the tale as to the starting of the fire. It is noticeable how ingenious electricians are in putting, by insinuation, the blame for these disasters on to gas. The "Electrical Times" tried it in the case of the Clapham fire—and ignominiously failed.

An Enterprising Electrical Editor.

Opportunity is a fine thing. There is a little-known paper called the "Electrical Field;" and it has an Editor who considered the tragic Clapham fire an excellent opportunity to obtain an advertisement for his paper. In the London and provincial press, there has appeared within the last few days a letter signed "The Editor of the 'Electrical Field,'" in which he stated that he fears the extraordinary publicity that has been given to the cause of the fire in South London will have likely lead to a wrong impression. "People," he says, "will have been led to believe that electricity is a dangerous illuminant. As a matter of fact, fewer fires are caused by electricity than by any other illuminating agency." Opportunity, we repeat, is a fine thing. The so-called "fewness" of the fires is simply due to the fact that electricity is not so extensively used as gas in respect both of the number of consumers and purposes. To prove his statement as to the fewness of the fires caused electrically, the Editor states that, from the last report issued by the Fire Brigade of the London County Council, it appears that, during 1908, 106 fires were attributed to electricity; while gas was responsible for 361 fires. In the "JOURNAL" for April 6 last (p. 14), we discussed these figures, but calculated that there were 366 fires due to gas, and 102 to electricity. On this point therefore, the Editor of the "Electrical Field" will not quarrel with us, as we attributed five fires more than he has done to gas and four less to electricity. Without taking any account of the hundreds of thousands of gas-fires, cooking-stoves, and other appliances in use in the Metropolis, it was found that the electricity fires equalled 1 to every 980 consumers, while the fires caused by gas spread over the actual number of consumers of the three London Companies equalled 1 in 2623 consumers, or spread over the (estimated) 1¼ millions of gas consumers in the areas served by the 29 London electricity concerns 1 in 3415 consumers. The calculations and other points will be found in the article published by us on April 6; and we would suggest that in those cities and towns where the letter of the Editor of the "Electrical Field" has been published, the corrective should be applied, through the same channels of publicity, by showing what his figures really represent.

A Gas Explosion before the Courts.

An endeavour on the part of a lady to fix upon one party or another the liability for a gas explosion by which she was injured while walking along the Fulham Road on the Tuesday following Easter in 1908, occupied the attention of Mr. Justice Phillimore and a Common Jury in the King's Bench division on two days of last week. Originally there were three sets of defendants to the action—the Gaslight and Coke Company, the Metropolitan Water Board, and Mr. Rogers, the proprietor of the tailoring establishment in which the explosion occurred. Before the case came on, Mr. Rogers was, by consent, dismissed from it; and during the hearing Mr. Justice Phillimore entered judgment in favour of the Water Board. This left only the Gaslight and Coke Company's liability to be decided by the Jury; and at the conclusion of the case, a verdict was given for them. This result was an unsatisfactory one from the plaintiff's point of view; but, as Mr. Danckwerts remarked when addressing the Jury on behalf of the Gas Company, though everyone must be sorry she had been injured, no one had a right to express his sorrow at the expense of someone else's pocket. The Gaslight and Coke Company denied liability on the ground that the explosion was primarily due to a leakage from a pipe of the Water Board washing away soil from underneath the gas-pipe; while the Board replied that they would not be liable, inasmuch as any leakage was not from their main, but from a service-pipe belonging to a customer on whom notice to repair had been served. As for Mr. Rogers, in his evidence he stated that at the time of the explosion no one was working in the shop, and all the burners were carefully turned off; so that he did not know what ignited the gas. A gas-stove in the back-kitchen was alight; but the explosion took place in the front basement, where there was no fire. Both gas and water pipes were found to be fractured; but Mr. Danckwerts pointed out that, as the action was simply based on negligence, it was necessary to prove injury from gas which escaped from the pipe through the negligence of the Gas Company. On the Thursday when the shop was closed, there was nothing wrong; and, this being so, he asked what evidence there was that the Gas Company could possibly have found out that there was an escape of gas. He attributed the fracture to the fact that leakage from the water-pipe which crossed the gas-pipe at right angles had caused subsidence; and subsequently the gas-pipe, being left unsupported, was unable to bear the weight imposed upon it, not, this time, by a steam-roller, but by what must be admitted to be an almost equally great infliction—a motor omnibus. All the evidence called for the Gas Company tended to strongly support this view of the case.

Electric Wiring and Gas Piping.

As has been remarked before in these columns, electric wires and gas-pipes are not, under any circumstances, desirable close companions in a house or other premises; and in the fitting up of a building of any kind by electricity in which gas is used, or *vice versâ*, a very precise specification for the work should be prepared and be carefully followed. Some time ago the Electrical Engineer of Glasgow called attention to the number of fires in the city that had been traced to the fusing of gas-pipes by electric wires and the subsequent ignition of the gas; and now the death of Mr. Alderman John Rooney, of Belfast, has to be acknowledged to be due to the same cause—the electrical fusion of a gas-pipe, and leakage of gas, which resulted in asphyxia. The fact that a branch gas-pipe was carried over an electric wire by a gas-fitter employed by Alderman Rooney shows that ignorance exists among gas-fitters—and the remark applies equally to electrical contractors—as to the undesirability of any close relationship between electric wires and gas-pipes. This is a matter that should be carefully impressed upon gas-fitters and electrical contractors in all towns. Had there not been contiguity between the gas-pipe and electric wire in this Belfast case, Alderman Rooney would, in all probability, have been in the land of the living to-day. At the inquest, there was much evidence of an academical order laid before the Coroner as to carburetted water gas and carbon monoxide; and there was danger of the more important question as to electrical fusion being lost sight of in the mass of statement made on this point. It would not have mattered in the least if the percentage of carburetted water gas had been much greater than is distributed in Belfast if the gas had not been let loose from the pipes. The relative toxicity of gases is a question of secondary importance; the primary one is the necessity for maintaining fittings in a gas-tight condition. It is absurd to say that the number of deaths has increased in the country since the introduction of carburetted water gas, without pointing out that, in the past twenty years, which about covers the period of the use of carburetted water gas, the consumption of gas has doubled. There is no evidence that shows that the number of accidental deaths—excluding suicides, which are really not accidental—has risen during that period in proportion to the use of gas. With the growth of traffic and population in London, the number of fatal accidents in the streets has increased; and that is a result every man of common sense would expect.

A Conference in the North.

One of the telegrams despatched from Berlin by Reuter's Agency on Friday said that "in consequence of the English coal strike, there is a recrudescence of activity in the German coal trade. The Westphalian Coal Syndicate is benefiting by large orders which in ordinary times are placed in England." Another statement of the same Agency, quoted from a foreign paper, is to the effect that "the English imports of Westphalian coal, especially bunker and factory coal, show a heavy increase, which is most opportune for the Ruhr Collieries, as they have large stocks in hand, and prices are rising." Thus the stoppages which have taken place in Durham and Northumberland have benefited Germany, while they have injured this country. If the miners will carefully consider the aspect of the matter which is here so clearly set forth, it should assist materially in urging them to settle their present unfortunate differences. Last Saturday, a conference was held between the Northumberland Coalowners' Association and the Miners' Association; and

there was certainly an air of hopefulness about the conclusion of the proceedings—it having been agreed that further meetings between the workmen and the management should be held at the individual collieries, with the view of endeavouring to arrive at a settlement "in the light of the conversations which had taken place between the representatives of the two Associations." At the headquarters of the Durham Miners' Association on Saturday, there was no intimation of any new stoppages having taken place, nor of any of the pits previously idle having restarted work. There is, however, an undoubted feeling that the prospect of a general strike is diminishing. It is impossible to say how far this brighter outlook has been brought about by the definite statement that no funds, either from the Durham Association or the Miners' Federation, can be applied to an unauthorized strike. But whatever may be the cause, it is certainly gratifying to be able to reproduce a report—even though it is so far unofficial—that at more than one colliery already ballots have been taken, with the result that a majority of the men are found to be in favour of returning to work.

Obituary.

The death occurred a few days ago, at his residence at Newton Grange, Dalkeith, of Mr. JOHN ROMANS, who was known to many of our readers as the head of the firm of Messrs. John Romans and Son, who carried on, in Edinburgh, business as suppliers of Scottish cannels, fire-clay goods, and pipes and apparatus for gas and water works. Deceased, who had reached the advanced age of ninety, had been for about sixty years a prominent political figure in Scotland.

The death occurred recently at his residence in Birmingham, at the age of 58, of Mr. HENRY DARWIN, who was well known in the gas industry in connection with his various inventions, especially for the inverted gas-burners bearing his name, one of which was noticed in our "Register of Patents" last week (p. 108). Mr. Darwin was for some years associated with the firm of Messrs. Wright and Butler, and while with them, in addition to producing his burner, made many useful suggestions for the improvement of gas stoves and radiators. The manufacturers of Mr. Darwin's burners are now Messrs. Charles Joyner and Co., Limited, of Birmingham, of which Mr. Butler is one of the Managing-Directors.

Hamburg Gasholder Disaster.—The "Journal für Gasbeleuchtung" reports that the Imperial Continental Gas Association have given, through their Berlin office, a sum of 1000 marks (£50) for the relief of the sufferers from this disaster.

Aix-la-Chapelle Gas Supply.—It is announced by the "Journal für Gasbeleuchtung" that the Municipality of Aix-la-Chapelle have decided not to renew the contract with the Imperial Continental Gas Association, which terminates on April 1, 1912, for the gas supply of the town. They intend to take the gas supply into their own management.

Projected Engineering Exhibitions in Manchester.—Under the auspices of the proprietors of the "Engineering Review," arrangements are being made for holding an Engineering and Machinery Exhibition in the City Exhibition Hall, Manchester, from Oct. 14 to Nov. 5 next. A Committee of twenty-seven, including representatives of some of the leading engineering firms in the country, are assisting the promoters in their endeavour to make this demonstration of machinery the finest that has ever been held in Lancashire. The Manager of the exhibition is Mr. Walter Cawood, who, it may be remembered, was the organizer of the successful Gas Exhibition held in Manchester in 1907. In the spring of next year, it is proposed to hold in the city a General Engineering and Allied Trades Exhibitions to be organized by the International Trade Exhibitions, Limited. The building is in course of erection in Rusholme.

Sulphate of Ammonia from Cyanamide.—At the meeting of the Alby United Carbide Factories, Limited, last September, reference was made by the Chairman to the business of the North-Western Cyanamide Company, Limited, and to the conversion of this product into other forms of high-grade fertilizers, which it was thought would be an important factor in ensuring the success of the Alby Company. According to a statement published by the Secretary of the Company (Mr. H. A. M'Mahon), the negotiations which have been pending between the North-Western Company and an important firm of chemical manufacturers for converting a large quantity of cyanamide into sulphate of ammonia have been concluded. The firm are now installing at Vilvorde, in Belgium, extensive plant for this purpose, the first unit of which, capable of producing from 6000 to 7000 tons per annum, is expected to be completed in March. So soon as this plant has been successfully inaugurated, the firm will, it is stated, be prepared to increase its capacity up to about 40,000 tons per annum. Terms have also been agreed in principle for the supply of 6000 to 7000 tons of cyanamide per annum to one of the largest and oldest manufacturers of fertilizers in Europe, for conversion into sulphate or phosphate of ammonia, and negotiations are pending with other important chemical manufacturers in various parts of Europe for similarly large supplies.

GAS STOCK AND SHARE MARKET.

(For Stock and Share List, see p. 196.)

THE Stock Exchange had a week full of incident and animation, swayed by varying currents and cross-currents; and the course of each market was impelled by its own special factors from day to day. The opening was calm on Monday; and the general tendency seemed to be to await election developments. Markets held pretty firm. Consols and other gilt-edged choices were rather better; Railways did nicely; the Foreign Market was firm; and the rest were not weak. Tuesday started firm; but later on was upset by a rumour, happily unconfirmed. Consols shrank a little, and, with the exception of Railways, the general tendency was weaker. On Wednesday, there was quite a lively outburst in the speculative quarters; some lines being decidedly animated. In more sedate departments, gilt-edged went rather heavily, but Railways were full of rise. On Thursday, the settlement (a fairly heavy one) was concluded. Fresh business was much restricted. Home Government issues were firmer; but Railways had a slight check. Americans were a weak spot. Friday opened dull and then brightened up, all the leading markets showing strength; but under New York influence, the Americans went from bad to worse. Saturday's tone was much the same. Consols rose $\frac{5}{16}$; but Americans were still lower. In the Money Market, there was a superabundant supply, upon which the large demand for the Stock Exchange had very little effect, and discount rates eased away steadily. Business in the Gas Market was scarcely as voluminous as the week before; but there was no diminution in the steadily growing strength of issues in undertakings both at home and abroad. The chief advance of the week was in Liverpool "A." In Gaslight and Coke issues, the ordinary had a further fractional improvement, and changed hands at figures ranging from $103\frac{5}{8}$ to $104\frac{1}{2}$. The secured issues were more than usually active. The maximum realized from $87\frac{7}{8}$ to 89, the preference from $103\frac{1}{2}$ to 105, and the debenture $81\frac{1}{2}$ and $82\frac{3}{8}$. South Metropolitan was not very active but quite firm, transactions being marked at $120\frac{3}{4}$ to $121\frac{3}{4}$. The debenture made $83\frac{7}{8}$ *cum div.* In Commercials, there were only a couple of deals each in the $3\frac{1}{2}$ per cent. at $104\frac{1}{4}$, and in the debenture at $81\frac{1}{4}$ and $81\frac{1}{2}$. Among the Suburban and Provincial group, Alliance and Dublin was done at $86\frac{1}{2}$, Brentford old at $255\frac{1}{2}$, ditto new at 191 (a rise of 1), Brighton original at 219, South Suburban at from 120 to 122, Tottenham "B" at $112\frac{1}{2}$, and Liverpool "B" at 167—a rise of 1. In the Continental companies, Imperial was quiet at from $175\frac{1}{2}$ to $176\frac{1}{2}$, the debenture marked $95\frac{1}{4}$, Union 97, European fully-paid $24\frac{15}{16}$, and ditto part-paid $18\frac{7}{8}$. Among undertakings of the remoter world, Buenos Ayres changed hands at $14\frac{3}{8}$ and $14\frac{5}{16}$, ditto debenture at from 99 to $99\frac{7}{8}$, Primitiva at from $7\frac{1}{8}$ to $7\frac{5}{16}$, ditto preference at $5\frac{1}{4}$ to $5\frac{5}{16}$, ditto debenture at 99, River Plate at from 17 to $17\frac{1}{8}$, ditto debenture at $98\frac{1}{2}$ and $99\frac{1}{4}$, San Paulo at $14\frac{3}{4}$, and ditto preference at 12 and $12\frac{1}{2}$.

ELECTRICITY SUPPLY MEMORANDA.

The Line of New Effort—Eclipses—Anticipations and Realizations—How an Electrical Writer Meets a Challenge—On Water Heating, Heat Conservation, and Water-Pans.

THE disappointing results of the past year's trading in the electric supply industry appears to be a common subject of conversation among electrical engineers and managers; and an attendant question is, as has been seen of late in the "Memoranda," what must be done to develop the domestic business? There is almost general agreement in electrical circles that the only thing to be tried now, to escape duplicate wiring and meters, and to give a fillip to the use of electricity for domestic purposes other than lighting, is something on the line of the Norwich or "telephone" system, under which a fixed charge is made per annum with a low flat-rate charge per unit of electricity used, no matter the purpose. The system is being tentatively adopted in many places. The Electrical Engineer of Liverpool has suggested that an experiment with the Norwich system be made for a year on quarterly terms—that is to say, the occupiers of private houses of not less than £20 rateable value to have the option of a supply on a fixed quarterly payment of 3 per cent. on the rateable value of the house, and a charge of 1d. per unit on each unit metered. We hear much about trials of this kind, but very little about results. If the idea were tempting consumers in large number, the news would be smartly winged around. But there is little information; and so it may fairly be assumed that, as a business cultivator, the system is not having prolific effect. Some electricity companies have been making a bold bid for custom in the wiring of new houses in the neighbourhood of London having rentals of about £30 to £35, and supplying when desired shilling-in-the-slot meters. The response to this is free gas-piping, and certain fittings, with shilling-in-the-slot gas-meters. And we believe this is answering well; one advantage, in addition to more light at less cost, being that consumers can have the convenience of a gas cooker.

In our review of the affairs of the electrical industry during 1909, a list of the failures of supply of which note had been made was included. It is, in passing, observed that the uncertainty of service is not one of the features of the retrospective writings in the electrical papers. Perhaps it is too much to expect of them. But,

when a water turncock at Sunderland inadvertently misapplied a key and cut off the gas supply in a certain district of the town, a leaderette appeared in an electrical paper (let it be nameless now) headed, if memory serves correctly, "The Biter Bit," regardless of the fact that cessation of supply is not a failure to which gas is perpetually subject as is the case with electricity. There were, as remarked above, several failures of the latter recorded last year; and this year has started badly. The list published on Jan. 4 did not include the breakdown on Dec. 28 of the supply at Dublin—the second within a few weeks—when private consumers, shopkeepers, and street lamps were involved; the private users only for about ten minutes, but the street lamps for the whole night. Last Monday evening, the people of East Ham were the victims of the perfidy of the electric current. The supply failed repeatedly—streets, business establishments, and private houses electrically lighted being plunged in darkness for three successive periods of five to ten minutes in the course of an hour after 8.15 p.m. To give business to the electricity undertaking, the street lighting by electricity is extensive. It is not in the interests of the ratepayers that the bodies responsible for local government should have any but the most reliable method of illumination in the streets; but the public safety is counted an insignificant matter when set against the increasing of the load on the electricity station. The Paris correspondent of the "Daily Telegraph" writing on Monday night last week, stated that one of the liveliest quarters of Paris—the vicinity of the Avenue de Clichy—had been subject to a partial eclipse of the electric light, which caused strange scenes in some of the cafés and music-halls. A short-circuit occurred on one of the big cables supplying electric light, which was followed by half-a-dozen similar accidents in various streets, so that the Electricity Company were compelled to shut off the current for the greater part of the night. It happened to be just at the time when the cafés and small theatres were filling up with people. The cafés had to resort to the usual expedient of candles stuck in the necks of bottles and to Chinese lanterns. The streets where electric light alone is used were completely in the dark.

The little Kentish borough of Gillingham, we fear, does not stand alone in respect of the internal troubles of its electricity concern. The Local Government Board some time ago saw that the undertaking was suffering from conditions which it was impossible to shake off; and it was also seen that the Corporation were not fully alive to the real position. The Board therefore advised the local body to have an expert investigation made; and this has been done—the examiner being Mr. J. F. C. Snell. What he has found at Gillingham, there is no question, applies to numerous other places. In the time when municipal electricity adventure was in full flush, and before experience had accrued, local authorities in the smaller towns were grievously misled by electrical advisers regarding the prospects of, and the necessary initial capital expenditure for, electricity supply. There are several stations to-day that have upon them a load of unproductive capital expenditure, and plant that is growing through insufficient use obsolescent, though of its kind in good condition, but, as things go to-day, uneconomical in working. Mr. Snell, in his report, asserts that the troubles of the concern are heavy and unnecessary capital expenditure, and a system that is not the most economical for the district. From this latter cause, the loss is considerable, as evidenced by the fact that in 1909 the units sold represented only 60·6 per cent. of the units generated. Owing to the heavy capital expenditure that would be involved, Mr. Snell is not in a position to recommend any serious change of system; and indeed so grave is the condition of the capital account, that he urges that no more money be spent, except when absolutely necessary. He, however, recommends certain improvements and changes which will involve an expenditure of some £3000, in order to give the undertaking a chance of doing something in producing economies with a view to a better financial showing. When the undertaking was inaugurated ten or eleven years ago, electricity was no doubt extolled as the means of lighting *par excellence*, the works described as second to none in the kingdom, the local councillors rubbed their hands gleefully in anticipation of profits to spend, and the ratepayers were congratulated on the business acumen shown by their local rulers. And now——. But let us leave it there.

One of the most delectable parts of the work of keeping oneself abreast of electrical view is the reading periodically of certain of the editorial matter that appears in the "Industrial Supplement" of the "Electrician." Sometimes it is prophecy, mingled with warning to the gas industry to prepare to meet its doom. Sometimes the writer postulates at large on gas matters, but rarely comes down to concrete points in proof. Sometimes he falls into humorous vein, and then writes much without having advanced anything definite that has not been said before, but showing remarkable agility in escaping from tight corners by avoiding figures, or else by limiting reply to some commonplace remark. We asked him on Dec. 21 to indicate what he meant by the "expensiveness" of heating water by gas, by showing the cost and duty rendered in comparison with the "Therol" electric heater. In "reply" to this, he refers us to the paper read by Mr. T. V. Fenn before the London and Southern District Junior Gas Association last May, and says this answers the challenge without going into figures, "which can be made to prove anything." What an easy means of escape! Does he actually know the relative costs for a given duty—duty embracing both quantity of water heated and time expended in the operation? Surely the writer of editorial matter in the "Industrial Supplement" of the "Electrician" ought not to have to rely solely on a paper read before a Junior Gas Association for support of such a dogmatic statement as that "it is expensive to employ this [gas] fuel for heating large quantities of water." Regarding his charge as to the unhealthiness of gas, we suggested to our friend that he should study the latest gas appliances and health and mortality statistics to see whether the year-by-year progress in the consumption of gas is having any real dire effect. And this is the puerility to which we are treated in reply: "We are requested to study mortality statistics as a proof that gas is healthy or is increasing in healthiness. There is, however, such a thing as slow poisoning; and while gas in the home may not be exactly deadly, it does not add to the general health of the household." That is why, we suppose, gas workers enjoy a longevity that is notable among industrial workers. Unless the "Industrial Supplement" writer finds pleasure in making himself the laughing-stock of his readers, he had better cease the writing of such ridiculous rubbish as this, and set himself seriously to work to positively answer questions put to him. Words only do not constitute argument.

It also now appears that the knowledge of the writer in the "Industrial Supplement" on the question of the "expensiveness" of gas for water heating—that is, gas at a straight price without any "scientifically" composed mode of charging—is extremely limited. He confesses the statement was not original, but was based on information given by Mr. Fenn in the before-mentioned paper read before the London Juniors. Our friend remarks that Mr. Fenn said that "except for one or two storey houses, gas heating of water was too expensive." That is not what Mr. Fenn said. What he did say was that "in large and *very* lofty houses, and where an *immense amount* of hot water is required, gas is too expensive"—that is to say, in comparison with coal-heated boilers, or preferably coke-heated circulators. Then, proceeding, Mr. Fenn observed: "Gas for the modern flat and a two-storey house, for hot-water circulation, is effective and economical, and should be pushed for all it is worth." There is a big difference between Mr. Fenn's actual statements and the interpretation the leader writer in the "Industrial Supplement" chose to put upon them; and it is seen now how little ground he had for his former assertion as to expensiveness. If he had only made inquiry of the Gaslight and Coke Company, or any other gas company, he would have found that the business in appliances for domestic water-heating has made remarkable strides of late; so much so that substantial undertakings have now to employ plumbers as well as gas-fitters. All this is being done without any scientific rules as to the use of the appliances or the prices charged for electricity. A case of the application of a gas circulator in a large house in the suburbs of London was only brought to our notice last week. The owner had found that in the winter time the heating of the water required in the place cost him for coal on an average 15d. a day; while in the past quarter, with a gas circulator in use, the expense only averaged 7d. a day. This is in a big house—one that cannot be described as a flat or a two-storey house—in which the bath-room has frequent use, and hot water is on tap often during the day.

Our journalistic friend, as we expected he would, while not denying that 6 cubic feet of gas contain as many thermal units as a unit of electricity, drags out that alleged mysterious property of electric ovens for usefully utilizing practically all the heat available from the electricity consumed, which is supposed to counterweigh the thermal difference between gas and electricity. Of course, the suggestion is that the oven can be cased in, and that there is no need for ventilation; and therefore there is no loss of heat—presumably not even through radiation. It is a pretty theory—for commercial purposes; but, in practice, we have not found a pennyworth of electricity go so far in useful heating effect as a pennyworth of gas. The "Industrial Supplement" leader writer obviously does not agree with what Mr. R. Borlaise Matthews, the author of the book on "Electricity for Everybody," wrote in "Electrical Industries," that certain types of cooker failed to properly cook certain items. "It is," Mr. Matthews continued, "difficult to say why this is so; but it seems likely to be due to *lack of storage* of heat in the oven itself, and absence of deflected or reflected heat from the oven top." Of course, the writer in the "Electrician" "Industrial Supplement knows much better than Mr. Matthews. Then as to the ventilation of electric ovens, "Maud" has written in the "Electrical Review:" "The only fault I have to find is the entire absence of a ventilator in the oven. The want of this ventilator means that there is always, when cooking, a fair amount of steam in the oven; and this tends to take up some of the heat which should be given to the contents of the oven." These are matters that were referred to in the "JOURNAL" for Nov. 9 last; and they suggest that the theory of the electrical press in this respect does not harmonize with practical requirement. One other point. Our friend is behind the times. We do wish electrical critics would keep themselves up to date in respect of improvements in gas appliances; it might save them falling into stupid error. This one refers to the "unpleasant dryness" associated with gas heating, and asks us to tell him why practically every gas-stove user employs at the same time a pan of water to moisten the air. Now how does this writer who only knew about the "expensiveness" of water heating by gas through a paper before the London Junior Association, know that practically every gas-stove user employs a pan of water. Not very long since we referred to this writer's prescience; now we find he claims to be omnispective.

It is false that practically every gas-stove user employs a pan of water to moisten the air. There was a time when the fad in this direction was fairly common; there were cases in which confessedly through faulty construction of fire there was some effect upon the humidity of the atmosphere. But the defects that produced this have been discovered and remedied. The water-pan is now a rarity. And what is more, an ordinary gas-fire will cause the air of an apartment to change between five and six times an hour. Does the electric radiator do this? Is there any other information the leader writer in the "Industrial Supplement" of the "Electrician" would like that is not in the paper read before the Southern Junior Gas Association?

GAS REFEREES' "NOTIFICATION" FOR 1910.

THE "Notification" of the Metropolitan Gas Referees for the current year, which was issued last week, contains a few alterations beyond the one that was noticed in the "JOURNAL" for the 21st ult. (p. 806).

At the end of the second paragraph, setting forth the duties of the Referees, the words "under section 39 of the Gaslight and Coke Company's Act, 1909," are added after "section 5 of the London Gas Act, 1905." In the instructions in regard to the service-pipes conveying the gas to the testing-places, the last sentence reads: "No testing for illuminating power *or calorific power* is to be made until after the lapse of an hour since the last washing-out." In the instructions as to the times and mode of testing for illuminating power, it is mentioned that "the gas supplied by the gas companies is required to have an illuminating power of 14 candles." The three Metropolitan Gas Companies are now on the same footing as regards illuminating power, by virtue of the Act obtained by the Gaslight and Coke Company last session.

The instructions as to the mode of testing the calorific power of gas now open with the following sentences:—

> **In the testing-places for the Gaslight and Coke Company, "one testing only for calorific power shall be made at each testing-place daily; but in the event of the calorific power being on any testing ascertained to be below 112½ calories, the Gas Examiner shall forthwith give notice thereof to the Gaslight Company, and a second testing shall be made at an interval of not less than one hour from the time of making the first testing at that testing-place, and the average of the two testings shall be deemed to be the calorific power of the gas at such testing-place on that day." (The Gaslight and Coke Company's Act, 1909, section 39 [2].)**
>
> **In the testing-places for the South Metropolitan Gas Company and for the Commercial Gas Company, the testing of the calorific power of the gas shall be made on such days as the controlling authority shall direct. (London Gas Act, 1905, section 5 [5].)**

The calorimeter used is to be one which has been examined and certified by the Referees; and a description of it is given in one of the appendices. In order to test the gas for calorific power, it is to pass first through a meter and an "efficient governor;" the words quoted taking the place of "a balance governor of the same construction as those on the photometer table," in the preceding notification. Then follow these sentences:

> **This may be a balance governor or a diaphragm governor of a pattern approved by the Gas Referees, and in the latter case the governor may conveniently be placed in the base of the calorimeter. When so placed, a non-conducting sleeve should be introduced into the burner-tube, to prevent the governor from being unduly warmed by conduction.**

In the section on the aerorthometer, it is mentioned, in accordance with the intimation given by Professor Vernon Harcourt in the number of the "JOURNAL" above referred to, that a second form of instrument, which has the advantage of being attached to the meter, and of having its bulb inside the meter case, is proposed as a substitute for that now in use. An illustrated description of it, on the lines of Professor Harcourt's communication, is given in one of the appendices.

A dinner will be held at the Waldorf Hotel, to-morrow (Wednesday), to celebrate the amalgamation of the Society of Engineers (established 1854) and the Civil and Mechanical Engineers' Society (founded 1859). Many distinguished guests have already notified their intention of being present. In view of the unique character of the event, and the fact that ladies may be present, a good attendance is anticipated—especially as this is the inaugural function in connection with the new Society which has been formed by the union of the two Societies mentioned as has already been referred to in our pages.

The Status Prize, consisting of books or instruments of the value of three guineas, will be awarded by the Society of Engineers each year for the four years ending 1913 for the best paper written by any person on the subject of "How to Improve the Status of Engineers and Engineering, with Special Reference to Consulting Engineers." The essays are to be of 4000 to 6000 words in length, and must be received by the Secretary (Mr. A. S. E. Ackerman, B.Sc.) on or before May 31 each year. All essays submitted will become the property of the Society; but the donor will have the right of publishing them or any part of them.

DESSAU VERTICAL RETORTS AT SUNDERLAND.

Results of the Guarantee Tests.

IN the "JOURNAL" for Nov. 23 last (p. 531), we published a photographic view of the installation of sixty 4-metre Dessau vertical retorts that have been completed at Sunderland; and referring back to July 6, a detailed description of the settings will be found. The bench has been at work now some five weeks under different conditions, to prove the best mode of working to meet the Sunderland requirements. But on the last days of the week ending the 8th inst., a test was made to prove the guarantees of the Dessau Vertical Gas-Retort Company; and the interesting results, as certified by the Engineer of the Gas Company (Mr. Chas. Dru Drury), are presented hereunder. The figures, as Mr. Drury points out, fully satisfy the conditions of the Dessau Company's guarantees:

AYRES QUAY GAS-WORKS—SUNDERLAND.

Result of Guarantee Test of Four-Metre Dessau Vertical Retorts.

Duration of test (10 a.m. Jan. 6 to 10 a.m. Jan. 8)	48 hours.
Number of retorts at work	60
Duration of charge (no steaming)	11 hours.
Coal carbonized (Holmside—Durham)	124·11 tons.
Gas made at 30·43" bar. and 48·7° Fahr.	1,430,000 c.
,, corrected to 30" bar. and 60° Fahr.	1,492,980 c.f.
,, ,, per retort	12,441 c.f.
,, ,, per ton coal carbonized	12,028 c.f.
Illuminating power (No. 2 Metropolitan burner)	17·55 candles.
Calorific power (gross)	635·4 B.Th.U.
,, ,, (net)	568·9 ,,
Coke used for fuel (dry)	17·33 tons.
,, ,, per ton of coal carbonized	13·96 per cent.

NOTE.—The figures given above for barometer, thermometer, illuminating power, and calorific power are the averages of observations taken hourly during the test. The gas was purified by oxide of iron only; and no air was admitted for revivification purposes.

I certify that I have checked the above results, and find them correct, and that they satisfy the conditions of the Dessau Company's guarantees.

Jan. 10, 1910. (Signed) CHAS. DRU DRURY, Engineer.

Breaking-Down the Gas.

Mr. Drury informs us that, since completing the guarantee tests, the retorts have been worked with twelve-hour charges, including one hour steaming; and the *approximate* results are as follows:

Number of retorts at work	60
Weight of average charge of coal	9¼ cwt.
Gas made per ton (corrected)	about 12,400 c.f.
Illuminating power ("Metropolitan" No. 2)	about 15½ candles.
Calorific power (net)	about 550 B.Th.U.
Sulphur (CS_2) in purified gas (oxide of iron only)	per 100 c.f., about 20 grains.
Number of stokers employed	one man per eight-hour shift, with one fireman per day only.

(This does not include labour on coal and coke elevating plant, which is done by yard men.)

The above figures, as mentioned, are approximate only; and it is hoped that better results than these will be obtained with greater experience and more regular working.

PROFESSOR DIXON ON FLAME.

LAST Wednesday afternoon, Professor Harold B. Dixon, F.R.S., delivered at the Royal Society of Arts the final lecture of his course, addressed to a juvenile audience, on "The Chemistry of Flame." After referring to the experiments of Boyle and Mayow, Priestley, Scheele, and Cavendish shown at the previous lecture (see *ante*, p. 98), by which it was demonstrated that part of the air—called "nitre air" or "fire air"—supported combustion, and that hydrogen united with this "fire air" produced water, the lecturer repeated some of the experiments of Lavoisier on the chemistry of oxygen, the name he gave to fire air. He showed that the oxygen existed in the steam and carbonic acid produced by burning a candle, and that it could be recovered again from the products of combustion. A flame was formed whenever one gas burnt in another; and air burns in coal gas just as coal gas burns in air. Then Sir Humphry Davy's experiments on the structure of a candle and a gas flame were shown; and Faraday's explanation of the light-giving part of the flame was proved to be not altogether correct. The effect of the mixture of air and of oxygen with hydrogen and coal gas was demonstrated, and the nature of detonation of gases and explosives was illustrated. It was pointed out that in each case a certain pressure must be reached in the combustion to make the mixture "detonate." Once detonation was set up, it continued at an absolutely uniform velocity, which could be predicted from the known constituents of the mixture. The enormously high temperature of a detonating mixture was shown by making an explosive mixture play on a lanthanum incandescent mantle.

THE LIGHTING OF SKATING-RINKS

As Illustrated by the Sydenham and Forest Hill Skating-Rink

The Illuminated Sign and Sugg's Inverted Burner Lamps at the Entrance to the Rink.

[Taken by Gaslight.]

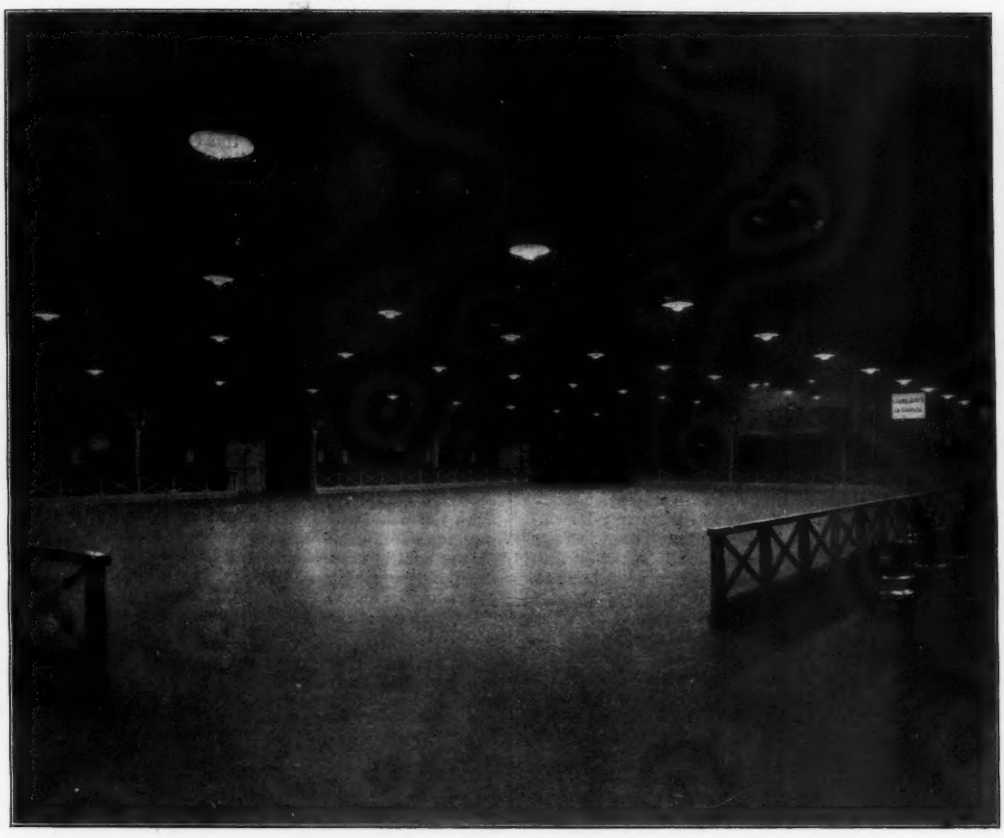
RINKING is the latest of English popular pastimes; the proper lighting of the rink is an art. The floor of a rink must be well lighted, and without shadows. The light must be steady and soft; and (this is a very important matter for consideration) not dazzling to the eyes of the rapidly moving skaters. A few high-power sources of illumination are therefore undesirable. Not only must the floor be illuminated without shadows, but the number of lights should be sufficient to ensure that there shall be no sharply defined shadows thrown by the skaters themselves. Dense moving shadows on the floor after one has had a few turns round a rink, spoil much of the enjoyment. The lighting, too, must be reliable and easily controlled. If these conditions are realized in the illumination of a rink, the pleasure of the exhilarating pastime is much intensified. Environment and prevailing conditions play a large part in the degree of one's pleasures. Amid the whirl and whir of the skaters, the writer was initiated into these points as to requirement in the illumination of skating-rinks, both from observation and in conversation with Mr. H. Baldry, the Distribution Superintendent of the South Suburban Gas Company, on, a few nights since, visiting the Sydenham and Forest Hill Skating-Rink to while away an hour or two; and he came away with information that may be useful to others who are considering the question of rink lighting.

The illumination of the place is excellent, the light is soft, there is an absence of irritating glare, the light is well diffused, and, as the merry throng were spinning round, it was noticed that there were no dense, sharply-defined shadows, such as are perpetually coming and going on a floor illuminated by high-power light centres, to worry the eyes and heads of the skaters. It is an excellent piece of lighting, demonstrating illumination propriety to purpose; and upon it Mr. Baldry, who (in consultation with his chief, Mr. S. Y. Shoubridge) was responsible for it, may be heartily congratulated. The installation was obtained by the South Suburban Gas Company in competition with the local Electric Supply Company; and the result is perfectly satisfactory to both the management of the rink and its patrons. The main part of the lighting is by Sugg's three-light inverted lamps, with domed reflectors. They are all on the low-pressure system; the supply being governed to 26-10ths. There is no missing the building at night time, as its position is marked in Silverdale, Sydenham, by three three-light Sugg "Regent" lamps, giving a combined illuminating power of 1500 candles. Over the entrance gate there is an illuminated gas-sign, the initial expense of which was borne by the Gas Company, in exchange for an advertisement; and on its face it bears the inscription: "Sydenham and Forest Hill Public Hall and Skating Rink, lighted and heated by the South Suburban Gas Company." Of course, the Skating Rink Company pay for the gas and maintenance. The maintenance, by the way, of the whole of the burners throughout the building is performed by the Gas Company. The sign (which is 12 feet long by 3 feet in height) was made for the latter by Mr. T. Pearce, of No. 274, New Cross Road; and the skating-rink management have in contemplation other gas illuminated signs—one in the main street, and one facing up Silverdale to the main street, directing to the rink. The outside lamps and sign are controlled by a main and bye-pass cock in a cupboard in the main entrance hall. Passing through, it is observed that over the front exit there is a single-light Sugg lamp (No. 1957) of 170-candle power. The entrance hall is lighted by two three-light inverted lamps of 500-candle power each; the manager's office, by a 75-candle power inverted burner; and the pay office by a one three-light bijou lamp of 270-candle power. The entrance is, as is every nook and corner in the place, well lighted without eye-distressing glare.

We come to the central feature of the lighting—that is to say the rink itself. The maple wood floor is 158 ft. by 107 ft. in area. Here the major lighting is by forty of Sugg's (No. 1959) three-burner inverted lamps, with broad dome-shaped reflectors, to give a good downward illumination. Lengthwise of the building, the lamps are arranged in four rows of ten—the two outer rows being 14 feet from the floor, and the two inner ones 16 feet—thus giving an arch form to their suspension, and so removing the monotony of uniformity. The total illuminating power of the forty Sugg lamps is 20,000 candles; and, as the consumption of gas is 440 cubic feet per hour, the efficiency of the lamps may be taken to be about 45 candles per cubic foot of gas consumed. The gas-services to the lamps consist of four 1-inch main supplies and four $\frac{1}{2}$-inch bye-pass supplies, which are reduced to $\frac{1}{8}$-inch tubes on the down-pipes to the lamps. It is important that the lamps should be absolutely under control, in order that they may be rapidly lighted up and extinguished for scenic effects, when coloured lights are thrown from the corners of the rink by means of four electric arc lamps, which constitute the only use of electricity in the building. To get this rapid control of the gas-lamps, the whole of the cocks for the main supply are assembled in a small recessed cupboard immediately outside in the entrance hall; and there, by means of a single hand lever, the whole of the forty lamps can, with the greatest facility, be extinguished (leaving only the bye-passes) and then lighted up again. It would, we think (having witnessed the complete success of the quick extinction and equally smart lighting-up of the gas-lamps) be impossible to conceive of a better arrangement; and for the purpose—illumination without glare and heavy shadow—a better diffused light over the whole floor could not possibly be desired. Near the band-stand is an illuminated sign, giving instructions from time to time to the skaters. This is lighted by four Bray "C" upright burners, which are controlled by a pneumatic switch.

With regard to miscellaneous lighting, over the raised band-stand at one end of the rink, there are two three-light bijou lamps, with an aggregate illuminating power of 540 candles. Over the exits are four "Nico" inverted lamps, giving together 300-candle power; and at a special exit six flat-flame burners are fixed. The rink is built in the grounds of a large house, which forms part of the property of the Rink Company; and a portion of this house has been usefully brought into use in connection with the general attractions of the place. There is the refreshment room, which is lighted by two two-light Sugg (No. 1958) lamps, with a total illuminating power of 680 candles, and two inverted burners, giving together 150-candle power. Adjoining is a pretty winter garden, fitted with two three-light bijou gas-burners, giving together 540 candles. The cloak and retiring rooms are also mostly fitted with incandescent burners.

Regarding the heating of the building, this is accomplished by Davis's steamless gas radiators. There are sixteen ten-tube ones (39 inches high), in the rink, arranged five at each side, and three at either end. There are also four in the entrance hall, two in the refreshment room, and one in the ladies' toilet. In the house, gas-fires are fixed in the ladies' cloak rooms and in the billiard rooms. All the hot water required is supplied by gas-heated appliances. In the refreshment room, the provision for hot water is ample and up-to-date for all purposes and demands such as there is any likelihood of the rink having to meet. An interesting and really fine piece of work (supplied to the Gas Company by Messrs. W. M. Still and Sons, Limited) is Jones and Still's patent 12-inch boiling water apparatus, with nickel-plated coffee-making machine combined. It is fitted with a $\frac{3}{8}$-inch gas supply, and a safety-valve to the water supply. Its delivering capacity is 150 pints of boiling water per hour, and yet the gas consumption is very small. On the opening day of the rink, the



The Illumination of the Rink Floor by Sugg's Three-Burner Inverted Gas-Lamps.

[Taken by Gaslight.]

machine had a severe test. The place was thrown open free, and afternoon tea was supplied free; and it is estimated that just over 2000 teas were served by the aid of this apparatus in little over an hour. It was only after the first hour that the machine failed to immediately respond to the demand for boiling water; and then merely a few minutes were required for it to recoup itself. Among other apparatus supplied and fixed by the Gas Company were a 1-gallon milk urn and a 1-gallon copper teapot. Over the sink in the refreshment room and in the retiring rooms, hot water is provided by a Wilson hot-water No. 1 circulator.

The whole of the work described was smartly installed by the Gas Company's men, under the direction of Mr. Baldry—six fitters (with six labourers) accomplishing the work in eighteen working days. In the fitting-up of the place, exclusive of connecting-pieces, tees, bends, &c., no less than 5135 feet of piping were used, comprising 220 feet of 2-inch pipe, 428 feet of 1¼-inch pipe, 1715 feet of 1-inch pipe, 838 feet of ¾-inch pipe, 1304 feet of ½-inch pipe, 216 feet of ⅜-inch pipe, 92 feet of ¼-inch pipe, and 322 feet of ⅛-inch pipe.

The result of the work is a fine demonstration of the illumination efficiency of low-pressure inverted gas-lights for the special purpose; and there is in the effect the testimony to completeness in scheming the arrangements.

GAS BILLS FOR 1910.

[Third Article.]

To-day, four of the Bills promoted by Statutory Gas Companies for extended powers are reviewed.

The first Bill is that of the Ammanford Gas Company, who were incorporated last year, and obtained parliamentary powers, with a capital of £18,000, and authorization to supply gas in Ammanford and Llandebie in the County of Carmarthen. The preamble of the present Bill carries the history of the concern a few steps beyond where it was left at the time of the passing of the Act last year. The Company were to take over the undertaking of the Amman Valley Gas Company, Limited—one of the Eaton group of promotions—on arbitration terms; the arbitrator appointed for the purpose (on the nomination of the Board of Trade) being Mr. Charles Carpenter. In the copy of the Bill before us, the amount of his award has not been filled in. The new Company, however, are now supplying gas. But they are living under the baneful influence of their predecessors' reputation; for we read in the preamble: "Whereas the circumstances connected with the promotion and history of the Limited Company have brought the said undertaking into discredit in the locality of Ammanford, with the result that it is impossible for an immediate issue of the capital of the Company to be made upon reasonable terms . . . it is expedient therefore that the purchase price should be discharged by the issue of debenture stock redeemable at the end of five years." It also appears that "the Company are unable to obtain satisfactory information as to the amounts of certain debentures issued by the Limited Company and the debts secured thereby, and the consideration received by the Limited Company for the issue thereof; and it is expedient therefore that special provision should be made as in this Act contained for distributing the debenture stock to be issued by the Company as aforesaid, and for ascertaining the amount thereof proper to be issued in respect of the debentures of the Limited Company." Further, "an action has been instituted in the Chancery Division of the High Court of Justice for the purpose of enforcing the security of the holders of debentures charged on the undertaking and property of the Limited Company, and in the said action R. & A. Main, Limited, are the plaintiffs and the Limited Company are the defendants." Mr. A. C. Hutchins has been appointed by the Court, and is acting as Receiver in the action. It is found, too, that the Limited Company only possessed a limited interest in the site of the existing works; and therefore the new Company want to acquire by compulsion or agreement scheduled lands. That is, as divulged in the preamble, the further history of the undertaking. Examining the clauses of the Bill in detail, provision is found in respect of certain of the matters referred to. It is asked that the area of supply may be extended so as to include Llanedy and a defined part of the parish of Bettws. Power is requested for the constructing, maintaining, and working of a railway siding at Tirydail, communicating between the Great Western Railway and the gas-works. Provision is included for the creation of a special class of stock, to be known as "purchase debenture stock," for a total amount equal to the price of the undertaking of the Limited Company; the stock to carry interest at the rate of 4 per cent. per annum—this constituting a first charge on the undertaking. A condition attaches, entitling the Company to redeem all or any of the purchase debenture stock by payment to the holder of the amount of principal and interest secured thereby, or by purchasing it from the holder by agreement at a price below par; the Company being bound to redeem at par the whole of the purchase stock outstanding at the expiration of five years from the date of issue, unless the holders agree with the Company in writing for the postponement of the redemption to a later date. This scheme, it is proposed, shall not affect the borrowing powers under the 1909 Act. The promoters also ask for authority to

require from the Receiver the production of reasonable evidence to prove the amount of principal and interest duly owing for proper consideration in respect of debts of the Company secured by the issue of the debentures of the Limited Company; and the Company, if they are dissatisfied with the evidence produced, desire to be allowed to require that the amount owing shall be determined by the Court on a summons to be taken out by the Receiver in the action pending by R. & A. Main, Limited. [*Parliamentary Agents: Messrs. Baker and Co.*]

The preamble of the Brighton and Hove Gas Company's Bill is a modest one; and several of the clauses in it are of ordinary form. Among other matters, they take power to enter into agreements with proprietors of navigations, &c., within the limits of supply. Power is taken to create reserve, special purposes, and capital redemption funds—the last named at the discretion of the Directors by half-yearly appropriations as part of the expenditure on revenue account of any sum not exceeding an amount equal to ¼ per cent. on the paid-up capital, including premiums, and all money borrowed or raised on capital account. The section is not to operate in respect of any half year immediately succeeding any period of twelve months ending either on Dec. 31 or June 30, during which the gas sold by the Company has exceeded the rate of 1 million cubic feet for each £500 of the paid-up capital for the time being of the Company, including premiums thereon and all moneys borrowed or raised on capital account and at the time outstanding. The amount of the carry-forward is limited to the equivalent of a year's dividends. There is a proposed amendment of section 17 of the Company's Act of 1881, referring to the Directors' fees. The alteration contemplates the reading and effect of the section to be as if the sum of £2250 had been inserted instead of £1500. A further amendment of former Acts, intends that the sections in view shall be read and construed as if the months of February or March and of August or September were substituted for the times prescribed by the former Acts for the holding of the half-yearly general meetings of the Company. From Jan. 1, 1911, the standard price of gas to be charged by the Company for gas supplied by them in Brighton, Hove, Preston, and Aldrington (the inner area), it is intended, shall be 3s. 3d. per 1000 cubic feet, with the sliding-scale operating half-yearly. But in the outer area, the price it is proposed shall not exceed that charged in the inner area by more than the following amounts: In Portslade, Southwick, Kingston, New Shoreham, and Patcham, and in part of Rottingdean as defined, 6d. per 1000 cubic feet; in Old Shoreham, Lancing, and Ovingdean, and in the remainder of the parish of Rottingdean, 1s. per 1000 cubic feet; and in any other parish or place within the outer area, 1s. 3d. per 1000 cubic feet. Notwithstanding, the Company provide that they may charge in any one or more of the parishes comprising the outer area, a price or prices less than those they are authorized to charge, subject to the reduced prices not being at any time less than the price charged during the same time within the inner area. The prepayment clause is inserted, but is varied by the provision that the charge for the hire of a prepayment meter without fittings shall not exceed the rate of 17½ per cent. per annum on the cost of the meter and its fixing. It is proposed that the prescribed illuminating power of the gas supplied shall be 15 candles, as tested by the "Metropolitan" No. 2 burner. [*Parliamentary Agents: Messrs. Sherwood and Co.*]

In the main, the Bill of the Bristol Gas Company is for money purposes. The Company request power to raise additional capital not exceeding in the whole £400,000 by the creation and issue of general capital stock. It is asked that the amount the Company may raise on mortgage, and in respect of which they may create and issue debenture stock in accordance with the provisions of the Acts of 1891 and 1899, may be increased by one-fourth part of the amount the Company may have actually raised by the issue of general capital stock under the powers of this Act. Authorization to the creation of a special reserve fund is desired. The promoters seek to be empowered, by agreement with the holders of debenture stock created and issued by the Company under the Act of 1873, to at any time redeem or purchase the same or any portion thereof. To the extent of the nominal amount of such debenture stock so redeemed or purchased, the power of creating and issuing debenture stock under this Act, it is proposed, shall be deemed to be increased. The object of this is to secure that the whole of the debenture stock of the Company shall rank *pari passu*. The Company are asking for the repeal of so much of section 21 of the Act of 1873, as relates to sulphur other than sulphuretted hydrogen, and to remove from them any liability to penalty or forfeiture by reason of the presence in the gas of sulphur impurities other than sulphuretted hydrogen. In the Act of 1873, the illuminating power of the gas was prescribed at 13½ candles; the testing-place being at the Corporation offices. It was then stipulated that, in the event of the testing-place being removed to the Company's works, the prescribed illuminating power should be 14 candles. These provisions were altered in 1891 by the substitution of 14½ candles for 13½ candles, and 15 candles for 14 candles. It is now proposed that the prescribed illuminating power of the gas be 14 candles, tested by the "Metropolitan" No. 2 burner—the illuminating power to be ascertained by taking an average of three consecutive testings on each day at intervals of not less than an hour. If on any day, the illuminating power is less to an extent not exceeding 1 candle than it ought to be, the Company (it is proposed) shall not be liable to penalty or forfeiture; but the illuminating power shall be deemed to be represented by the average of the illuminating power of the gas supplied on that day and on each of the two next following days, with no liability to penalty unless the average illuminating power be less than that prescribed. Sunday testing is excluded. The Company are asking for power to deal with escapes of gas on consumers' pipes or fittings, by cutting off the supply if the escape is not remedied in twenty-four hours after the service of a notice by the Company. They further desire power to require the alteration of the position of a meter in certain cases. As to the exercise of the powers of section 22 of the Gas-Works Clauses Act, 1871, in regard to unoccupied premises, the Company ask—where they are unable, after due and reasonable inquiry, to ascertain the name and address of the owner or lessee of such premises or of the agent—for the right to enter the premises for the purposes of the section without giving the notice thereby required. Obligations in regard to the supply of gas are amended by this provision: "Notwithstanding anything contained in any enactment to the contrary, the Company shall not be obliged to give, from any main, a supply of gas for any purpose other than lighting in any case where the capacity of the main is insufficient for such purpose, or if and so long as any such supply would, in the opinion of the Company, interfere with the sufficiency of the gas required to be supplied by means of such main for lighting purposes." Stand-by supplies are also dealt with—the Company asking that, where a consumer has a separate service, he shall not be entitled to demand a supply from the Company's mains, unless he has previously agreed to pay such minimum annual sum as will give a reasonable return on the capital expenditure and standing charges incurred to meet the possible maximum demand for the premises. The following provisions refer to the appointment of a Managing-Director of the Company:

> The Directors of the Company may appoint any one of their body to be Managing-Director of the Company either for a fixed term, or without any limitation as to time, and may remove or dismiss him from office, and appoint another in his place.
>
> A Managing-Director shall not, while holding that office, be subject to retirement by rotation, and shall not be taken into account in determining the rotation of retirement of Directors; but if he ceases to hold the office of Director from any other cause, he shall *ipso facto* immediately cease to be a Managing-Director.
>
> The remuneration of a Managing-Director shall from time to time be fixed by the Directors, and may be by way of salary or commission or participation in profits or by any or all of those modes.
>
> The Directors may entrust to, and confer on, any Managing-Director such of the powers exercisable by the Directors, and subject to such conditions, as they may think fit, and may from time to time revoke, withdraw, alter, or vary, all or some of such powers. Provided that the Directors shall be responsible for the acts of any Managing-Director acting under the powers of this section.

The Directors also take power to determine the salary paid to the Secretary. [*Parliamentary Agents: Messrs. Dyson and Co.*]

The East Grinstead Gas and Water Bill is chiefly concerned with water supply, in which respect the provisions will be noticed in due course when dealing with the water measures. Sanction to the raising of additional capital to the amount of £40,000 is asked, on which the dividend is to be limited to 7 per cent. The new auction clauses are to be adopted. Borrowing powers to the amount of one-fourth are requested. [*Parliamentary Agents: Messrs. Rees and Freres.*]

WORKMEN'S COMPENSATION STATISTICS.

In the course of an article in Saturday's "Pall Mall Gazette," Mr. G. A. Macdonald deals with some unexpected results of the extended liability of employers which was brought about by the Workmen's Compensation Act of 1906; and he points out that it is under pressure exercised by the Insurance Companies that the working classes are feeling the disastrous effects of the Act. They are, he says, insisting upon certain physical standards on the part of workmen before they will undertake the risks laid on employers by the Act; and the pressure under this head will increase, for insurance rates are rising, and the conditions of policies get more severe as the scope and working of the Act become clear. Employers report that, notwithstanding all expedients for minimizing risks, the average disbursements for compensation rise steadily; and the insurance premium is now a serious addition to establishment charges. We are, he thinks, approaching the time when a strict medical examination will be necessary before the responsibility of engaging a workman can be undertaken; and he asks, "Will the leaders of the Labour Party in this country ever learn that the laws which govern the economic relationships of men are not as club rules, to be abrogated at will?"

In view of these uncompromising expressions of opinion, it may perhaps not be out of place to give some official figures from the most recent Home Office statistics (for 1908) of compensation and of proceedings under the Workmen's Compensation Act, 1906, and the Employers' Liability Act, 1880. This Blue-Book is of special interest on the present occasion, inasmuch as the period dealt with is the first complete year in which the 1906 Compensation Act was in force—it having become operative in July, 1907. Under section 12 of the new Act, the Secretary of State is empowered to require employers in any industry specified by him to furnish annually information as to the number of cases of compensation, the amounts paid, &c. The earlier Acts contained no

provision for the making of returns to show the working of the systems of compensation which they established; and the sources from which official statistics could be obtained were therefore limited to those cases in regard to which some sort of proceedings ensued—the great majority of cases (those in which a settlement was arrived at by agreement) being perforce left out of consideration. Thus the present volume commences a new series of statistics. Previously, seven groups to which the Acts applied were included—railways, factories, mines, quarries, engineering work, building, and agriculture. Under section 12 of the new Act, however, the Secretary of State directed that returns should be made for mines, quarries, railways, factories, harbours, docks, &c., constructional work, and shipping (excluding sailing vessels in the sea-fishing service); these being the industries which, by reason of their being subject to regulations under other Acts, or of their concentrated character, afforded a possibility of obtaining returns sufficiently complete and accurate to be of value. In addition, however, to the statistics of compensation cases in the industries included in the order of the Secretary of State, general particulars, similar to those published in previous years, are given in regard to the administration of the Acts. A few figures from Part I. (statistics of compensation cases in certain industries) are set forth here; reserving Part II. (administration of the Acts) for future consideration.

The information asked for by the Secretary of State was the number of fatal cases in which compensation was paid during the year and the amount—distinguishing cases where persons wholly dependent, cases where persons partly dependent, and cases where no dependants were left; the number of disablement cases in which compensation was paid during the year and the amount—distinguishing cases continued from previous years and cases in which the first payment was made during the year; the duration of the compensation in disablement cases; and the settlement of disablement cases by lump sum payments. The returns were of two kinds—collective returns supplied by insurance companies, employers' associations, and others; and returns direct from individual employers. Of the latter 34,659 were received—no less than 31,416 being to the effect that there had been no cases of payment of compensation under the Act of 1906, to which, of course, the powers contained in section 12 are confined. Contracting-out schemes, payments under the earlier Acts, and damages under the Employers' Liability Act, are not included. The figures do not, therefore, it must be remembered, represent the total charge upon the different industries in connection with the payment of compensation to persons employed in respect of injuries received. The gross total of compensation paid in the seven groups of industries named during 1908 under the Act, as shown by the returns, was £2,080,672, and represented 3473 cases of death and 325,484 cases of disablement. The gross total of the persons employed in the seven groups of industries is shown by the returns to be about 7½ millions; but it is thought that the figures for some of the groups of factory industries are possibly overstated. As was only to be expected, during the first year, difficulties were experienced in collecting the returns; the number of undertakings to be dealt with being between 130,000 and 140,000. The Act, it may be pointed out, gives power to prosecute employers failing to make the required returns.

Coming to the separate industries, the first dealt with is shipping. In 371 fatal cases, the compensation paid was £61,333—an average of £165 per case; and in 5877 accidents involving disablement, the compensation was £51,519—showing an average of £8 15s. per case. The total number of seamen returned as being within the Compensation Act was 235,001; and the compensation paid in the year works out at 9s. 7d. per head. In considering the figures relating to this industry, however, there are numerous special conditions to be borne in mind. For instance, no compensation is payable under the Act in cases of disablement in respect of the period during which the owner is liable under the Merchant Shipping Acts to defray the expenses of maintenance of injured seamen.

The next returns are in respect of industries carried on in factories to which the Factory and Workshop Act, 1901, applies. Workshops under the same Act are not included. The classification is under ten groups: Textile—Cotton; wool, worsted, shoddy; and other textiles. Non-textile—Wood; extraction, founding, and galvanizing of metals, including conversion; marine, locomotive, and motor engineering, and shipbuilding; manufacture of machines, appliances, conveyances, and tools; paper, printing, stationery, &c.; china and earthenware; and miscellaneous. The returns indicate that the number of fatal accidents in which compensation was paid in the year was 951, with £130,506—or an average of £137; while the number of disablement cases was 136,357, with £660,301 compensation—an average of £4 17s. per case. The number of persons employed amounts to 5½ millions. Both the number of cases in which compensation was paid and the persons employed are in excess of the corresponding figures reported under the Factory Act; but the compensation statistics cover a somewhat wider field, as they include outside as well as inside hands. On a rough estimate, the number of accidents that disabled for more than seven days would seem not to have exceeded 100,000. Compensation for industrial disease was paid in 24 fatal cases to the amount of £3620—an average of £151; and in 542 disablement cases to the amount of £7617—an average of £14. The total charge for compensation under the heading of factories was £802,044; and it works out, on the number of employees returned, at 1s. 6d. per head in the cotton industry, 9d. in the wool, 6s. 3d. in the metal, and 12s. in the engine and shipbuilding industries. On a rough calculation, the charge comes out approximately at 3s. 5d. per £100 of wages for the cotton trade, 2s. 2d. for the woollen trade, and 2s. 2d. for the other textile trades.

In connection with docks, the compensation for 156 fatal accidents was £21,254—an average of £136. There were 10,591 disablement cases, with compensation amounting to £65,220—an average of £6 3s. Compensation was paid for industrial disease to the extent of £254, making the total compensation £86,728. On a total number of employees of 67,929, the compensation works out at £1 5s. per head.

The returns in respect of the mining industry appear to have been fairly complete. The approximate average number of persons employed to whom the Act applies is 1,047,862. The compensation paid in respect of 1301 fatal accidents was £226,226—an average of £174; and in 137,622 non-fatal cases, £601,848—an average of £4 8s. A sum of £13,382 was paid in connection with diseases, making the total charge £841,456, the great bulk of which naturally fell upon the coal industry. At the coal mines, there were 1285 fatal accidents, out of 1345 reported under the Mines Act as the total number of deaths by accident in 1908. The charge of the Compensation Act on coal-producing mines is about 0·7d. per ton raised. The number of persons employed in coal mines during the year, both above and below ground, was 972,232, so that the compensation that was paid amounts to not quite 17s. per head.

During 1908, there were 6938 quarries over 20 feet deep at work, in addition to a number of shallow open workings. For 88 fatal accidents there was paid £11,501—an average of £131; and for 5284 disablement cases, £23,056—an average of £4 7s. The amount of compensation paid in respect of industrial disease was £241, making a total charge of £34,798. Taking the figures of persons employed as returned to the Inspectors of Mines (85,475), this represents a charge of only about 8s. per head.

Under the head of constructional work, the returns can only be regarded as approximate. The intention was to cover as nearly as possible the large body of men engaged on what are known as engineering works—buildings (except when forming part of an engineering work) being excluded. The number of fatal accidents reported was 119, with total compensation £13,551—an average of £114; and of disablement cases 6805, with £38,269 compensation—an average of £5 12s. Compensation was paid to the amount of £108 in respect of industrial disease, making the total charge £51,928, or 8s. 2d. per head on the number of employees returned.

From the railway companies there is a prominent omission—the Great Eastern, who have a contracting-out scheme. Among the clerical staffs, only 3 fatal accidents and 39 disablement cases were returned, in respect of 54,508 employees, with total compensation of £355. In connection with the 396,884 other railway workers, there were 458 fatal accidents, with £67,515 compensation—an average of £147; and 20,649 disablement cases, with £82,924 compensation—an average of £4. Some of the latter were payments continued from the previous year. The compensation paid for disease was £72. During the year, the total compensation paid for railway servants (other than clerical staffs) works out at 7s. 7d. per head of the number employed. Taking the Board of Trade figures as to average weekly earnings of railway servants, and excluding the clerical staffs from the total of persons employed, the compensation charge for the year works out at about 14s. 6d. per £100 of wages paid.

One table shows the duration of compensation for disablement; and in regard to this it is remarked that the high proportion of cases lasting over two weeks and less than three, is striking. This group accounts for 27 per cent. of the whole number of cases in all the industries, and in mining as much as 31 per cent. Under the Act, cases where the incapacity lasts less than two weeks receive compensation only for the days of incapacity in the second week; whereas cases which last at least a fortnight receive compensation for the first week of incapacity as well.

THE HAMBURG GASHOLDER DISASTER.

By F. S. Cripps, Assoc.M.Inst.C.E.

Gasholders of the vaulted tank type have many weak spots; but, above all, it is necessary that the water level inside the holder should never fall below the level of the roof of the tank. The roof should always be covered with a film of water, otherwise the slightest leak in the roof allows of the gas escaping into the vault below. The gas, being at a higher pressure than the air, forces its way downwards through any leak, displacing and mixing with the air below, thereby causing an explosive mixture.

The moral of this is that at least two water-level gauges or indicators should be fixed, to show the exact depth of water covering the roof of the vault. Two gauges are required in case one should get out of order or blocked. The water-gauge must not be open to the atmosphere, but in connection with the gas pressure inside the holder, as well as the water, or the water-level will vary in the gauge just as it does in the tank outside the holder. A water-level recorder should also be fixed, so that the engineer of the

works may know that the water has been kept at its proper level at all times. Unless some such precaution as this is taken, the risk is very great indeed.

Observation of the water level in the annular tank outside the holder is apt to be misleading, owing to the fact that the levels inside and outside do not agree. Although outside the holder the levels vary according to the number of lifts in suspension, the level inside remains practically stationary after the holder has once been fully inflated, unless the tank leaks. Of course, common sense demands that a watchful eye should be kept on these gauges. Indeed, the same care should be exercised as is called for in countless other similar ways on a gas-works, and which form part of the ordinary routine of a gas manager's duties. As an extra precaution, it would not be difficult to arrange for an alarm bell to ring inside the vault, as well as in other parts of the works, immediately the water level becomes lower than the normal.

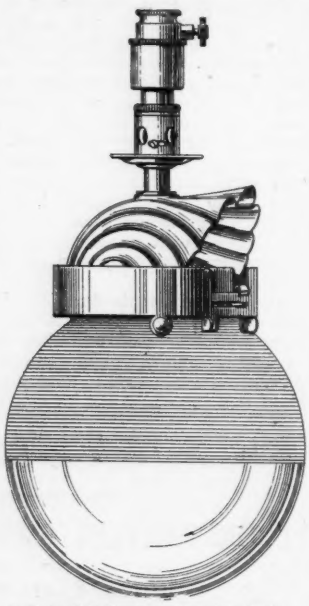
It is obvious that if water always covers the top of the tank, gas cannot possibly enter the vault from the holder; so that, providing the structure is strong enough to resist the forces acting upon it—that is does not collapse under the load, &c.—no explosion can occur in the vault by reason of gas escaping from the gasholder itself. Explosions may occur therein from other causes, just as they may in a private house; but they could not be attributed to any leakage from the gasholder itself.

It may be asked, What should be done to avoid an accident if the water level is shown to be falling? If the lowering of the water level should be caused simply by evaporation, it would only be necessary to put more water in the tank, and to keep it constantly replenished. If, however, it should be due to leakage, or, in any case, if the top of the vault became unsealed, all lights and fires inside the tank and in the immediate vicinity of the holder should be extinguished at once. No time must then be lost in making good the water level and emptying the holder of gas, so that the defects, whatever they may be, can be made good with safety.

As an outcome of the disaster at Hamburg, it should be made compulsory that gauges and recorders should be fixed in connection with all gasholder tanks of the over-ground vaulted type.

AN INVERTED BURNER ANTI-VIBRATOR.

Attention has been drawn to another one of those useful little contrivances which assist in increasing the efficiency of the inverted burner as a lighting medium. This time it is an anti-vibrator, which Messrs. J. & W. B. Smith, of the Farringdon Road, are putting upon the market. The accompanying illustration shows the appliance fitted to one of the firm's "Shell" burners; but, unless any doubt should be raised on this head, it may at once be mentioned that it can be supplied with a screw thread to fit any burner of whatever make. The anti-vibrator is so compact in construction (besides being enclosed in a brass casing) that at a first glance one might almost be pardoned for altogether overlooking it. On a careful scrutiny, however, it will be noticed that it is fixed between the gas adjuster and the air adjuster; the length of the burner connection by its addition being increased not more than about one inch. When the casing is unscrewed, it is seen that the anti-vibrator consists of a coil spring which, though small, is amply sufficient to perform the duty that is required of it. Being so simple, the cost of the anti-vibrator is exceedingly moderate; and this should assist in securing a wide demand for it.



A "Shell" Burner, showing Anti-Vibrator Fitted.

Masonic.—Last Thursday Bro. William Langford, of Longton, was installed W.M. of the "Etruscan Lodge," No. 546. The ceremony took place in the Masonic Hall, Caroline Street, Longton, and was attended by a large number of Grand Officers of the Provinces of Staffordshire, Lancashire, and Yorkshire. There were several interesting features in connection with the working in the lodge. First, the united ages (in Masonry) of the Past Masters occupying the Wardens chairs and the Inner Guard, amounted to 135 years, or an average of 45 years each. Secondly, the incoming Master was honoured by the presence of the D.C. of the Grand Lodge of England as the D.C. of the lodge, in the person of W. Bro. G. C. Kent, the Town Clerk of Longton.

STRASBURG GAS-WORKS AND SUPPLY.

[Concluding Article.]

As intimated at the close of the second article on Strasburg, in the "Journal" last week (p. 93), the concluding article on M. Gaston Kern's interesting book on the gas supply of the city will be devoted mainly to the public lighting.

M. Kern appropriately opens this portion of his subject with a notice of the life and work of Dr. Auer von Welsbach, and then tells us something about the adoption of the incandescent system of gas lighting in Strasburg. The first appearance of Welsbach burners in the city was in 1886; but their high price was a bar to their general adoption. It was not until 1890 that the burner was brought within the reach of ordinary consumers, and that its economy as a light-giver rendered it popular. The then Mayor (M. Back) was desirous that Strasburg should, as soon as possible, enjoy the advantages afforded by Dr. Auer's invention; and after a trial of the system, extending over two years, in the Place Broglie, the Municipality, on Jan. 19, 1900, concluded an agreement with the Union des Gaz Company for the general introduction of Welsbach burners for the public lighting. By the 1st of October in the same year the change to the new system had been duly effected. This was a complete victory over electric lighting, for, under the terms of the Company's concession, the Municipality had the right to make a trial of the electric light in one-fiftieth of the area within the fortifications. They availed themselves of it from 1890 to 1894, and lighted the Place Broglie and some neighbouring streets. The installation cost 45,000 marks (£2250), and the price charged for current was so high that the scheme was abandoned in 1898 in favour of gas. It is scarcely necessary to say that the Company did not fail to fully maintain their supremacy. They accordingly offered the Municipality two very fine five-branch standards in the Place Impériale, each branch supporting a five-burner lamp. Each standard projected from a height of about 20 feet an amount of illumination equal to 2500 candles, and compared very favourably indeed with the electric arc lamps. The electric lighting in the railway station square, which had been in use for about ten years, gave place to Welsbach burners when these were generally introduced in 1900. The firm of Himmel, of Tübingen, undertook the installation of six monumental three-branch standards, each lantern containing five 100-candle Welsbach burners. One of these is shown in the accompanying illustration and a two-branch standard by the same firm is shown in fig. 3. In this installation Herr Himmel brought into use for the first time his patent arrangement for lowering and raising the lanterns (see fig. 2). With the exception of being rather expensive to keep up, these lamps have for a number of years given entire satisfaction. A very fine wrought-iron standard, carrying three lamps, erected in the Place Gutenberg, is shown in fig. 4; and a single-lamp pillar, on the Ponte de la Poste, in fig. 5. Various other installations of less importance, using inverted burners and high-pressure gas, have been put up; and the system of distance lighting has now been introduced in the extra-mural quarters of the city, to which there was little prospect of electric lighting being extended, and where the control of the lamplighters gave some trouble. The occupation of these functionaries, however, will soon be gone.

On the 30th of April, 1908, there were in use 5624 public lamps. While for these the upright mantle has, with very few exceptions, been retained, the private consumers generally prefer the inverted type of burner. M. Kern thinks that this burner would not have sufficed to enable the Company to meet the competition of electricity if distance lighting had not come to its aid; and Strasburg was one of the first cities in Europe to adopt it on a large scale. Preliminary studies led to the abandonment of all flash-light arrangements, and the adoption of the "Multiplex" electric system, devised by Herr von Mohrstein, of Berlin, which has given entire satisfaction for a period of six years. Of the 140,000 gas-burners in use in the Company's area of supply, about half of them are upright and one-fourth inverted incandescents, and the remainder are open-flame jets. Up to the time of the preparation of the book, the Company had been entrusted with the maintenance of about 3000 Welsbach burners, all fitted with "Multiplex" lighters. The greater number of these are in restaurants and beershops; but some are employed in large warehouses. The system has proved a powerful corrective of the infatuation of the public for the electric light; and in many cases it has led to the return of some of the Company's lost customers.

These improvements in lighting, however, are not the only means employed by the Company to maintain and strengthen their position. They offer special inducements, in the way of gratuitous installations, to consumers to take a supply of gas, which is charged at a reduced price if used for heating or cooking; while rebates are allowed for large quantities. Meters, stoves, and fittings are let on hire on the most reasonable terms. The hiring department is in a special part of the works, and has a staff to renovate all appliances returned from consumers. Those which are too worn or are out of date are sold, in order to avoid accumulations of old goods. In 1908, there were sent out 4080 meters and 4222 stoves; while 2544 of the former and 6585 of the latter were returned, consequent principally on change of abode. The Company vary from year to year their methods of increasing the use of gas by means of advertisements, literature, lantern pictures, and posters. In 1892, they invited the artists of

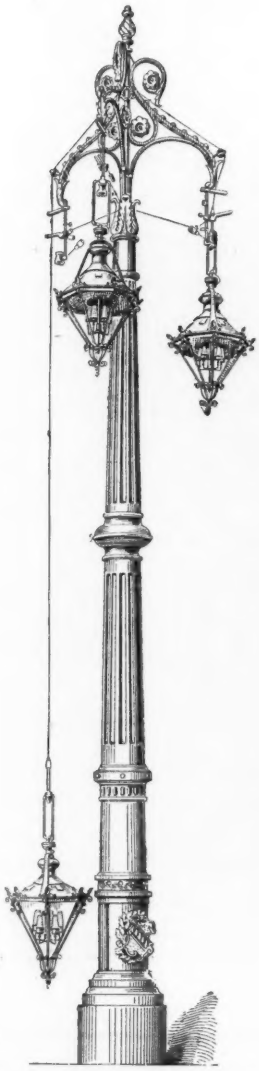


Fig. 1.

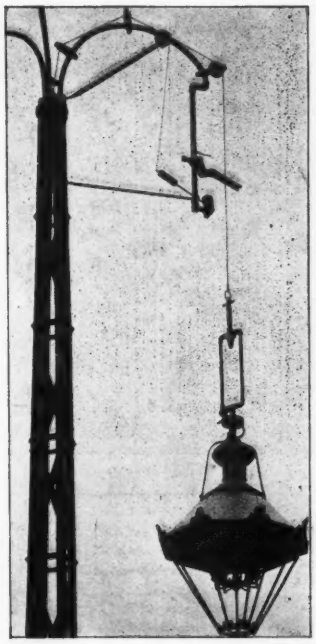


Fig. 2.

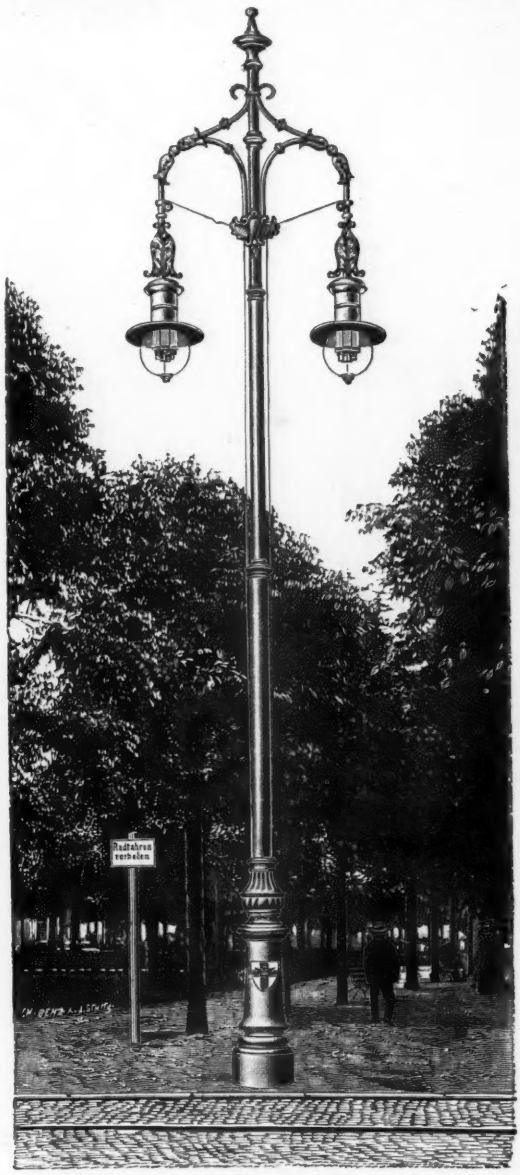


Fig. 3.

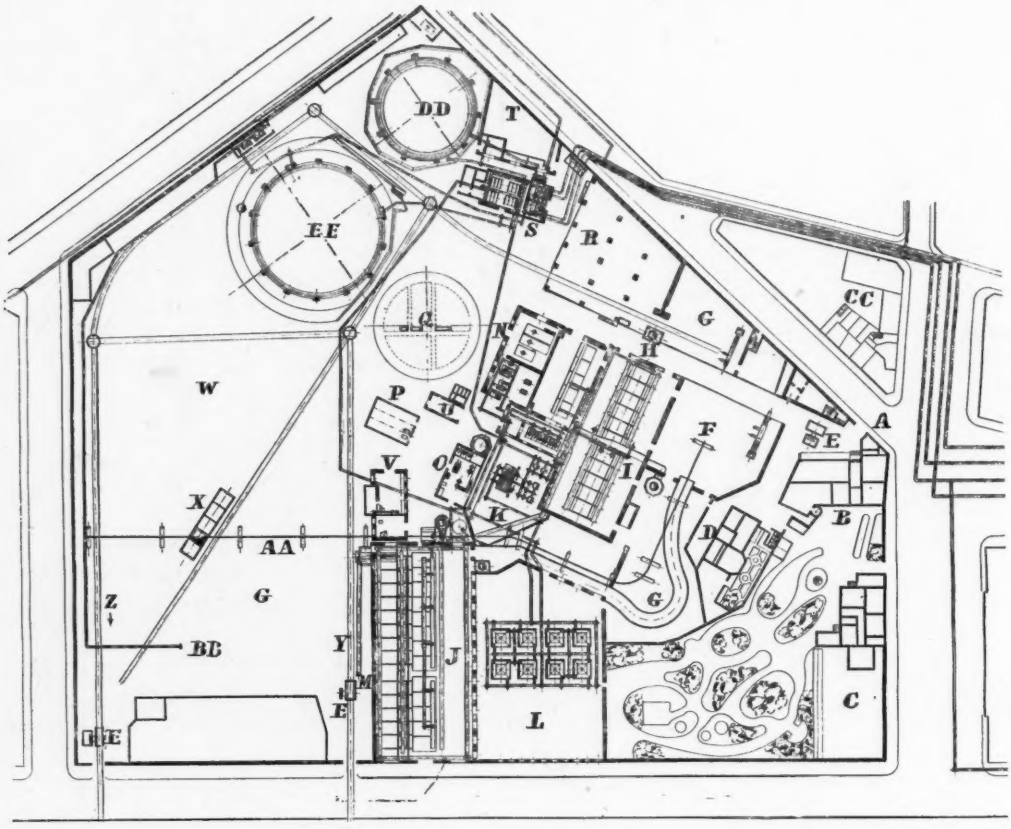
Fig. 4.

Fig. 5.

Strasburg to compete for prizes for an effective pictorial advertisement. The subject given was a bird's-eye view of the city by night, lighted by incandescent burners. The three prizes were 250 frs., 125 frs., and 75 frs. The picture was 20 in. by 28 in. The Queen of Night was the title of the one submitted by M. Eugène Moeckler, of Strasburg; and a very effective coloured reproduction (7 in. by 10 in.) appears in M. Kern's book. The picture was so good that it was hung in the halls of hotels, restaurants, and beershops, and was even admitted into the anterooms of the Government and municipal establishments.

From the year 1900 onwards, several contracts were entered into by the Company for increasing their business. In 1901, the Treaty concluded with the important commune of Schiltigheim in 1866 was prolonged; in 1902, the commune of Hœnheim, lying to the north of this place, was added to the area; and in 1904 the commune of Lingolsheim, on the east of the city, was taken in. In the same year, the Municipality submitted to the Company a scheme for extending the public lighting all over the outskirts, partly lighted by oil and partly unlighted. It was a question of putting down about 15 miles of mains; and it necessitated entering into a fresh agreement, which was concluded on June 13, 1904. The most important extension undertaken by the Company was the acquisition in 1905 of the gas-works at Kehl, a small Baden town of about 4000 inhabitants, which was rebuilt to a large extent after the bombardment of Strasburg. The idea of enlarging the gas-works in the city by an annex erected outside had been for a long time entertained; and the situation of the works at Kehl appeared to meet all the requirements. These works were constructed in 1861; and in 1905 they occupied an area of about 4320 square yards, and were producing about $3\frac{1}{2}$ million cubic feet of gas per annum. After having acquired some 22,000 square yards of land to round-up the property, the Company proceeded in 1908 to construct new works capable of producing from 500,000 to 700,000 cubic feet of gas per day. They are situated at the extremity of the Company's mains, and are connected with Strasburg by two 6-inch pipes laid in the north pavement of the bridge crossing the Rhine. The new station is intended to furnish an auxiliary supply of gas to the extent of 10 per cent. of the requirements of the consumers; and a special agreement was entered

STRASBURG GAS-WORKS IN 1908.



A. Entrance.
B. Offices.
C. Manager's House.
D. Carbonizing Foreman's House.
E. Weighbridges.
F. Coke Shed.
G. Coke Ground.
H. Coke-Quenching Tower.
I. Old Retort-House.
J. New Retort-House.
K. Condensers and Washers.
L. Purifier House.
M. Conveyor.
N. Exhausters and Boilers.
O. Sulphate House.
P. Tar Tanks.
Q. Liquor Wells.
R. Coal Store (Workmen's Rooms above).
S. Meter and Governor House.
T. Stores.
U. Smithy.
V. Workshops.
W. Coal Ground.
X. Coke Sorting Shed.
Y. Entrance for Waggons.
Z. Exit for Waggons.
AA. Overhead Railway.
BB. Pipe for Filling Balloons.
CC. Laboratory.
DD. Three-Lift Holder (318,000 c.ft. Capacity
EE. Four-Lift Holder (876,000 c.ft. Capacity).

PLAN.

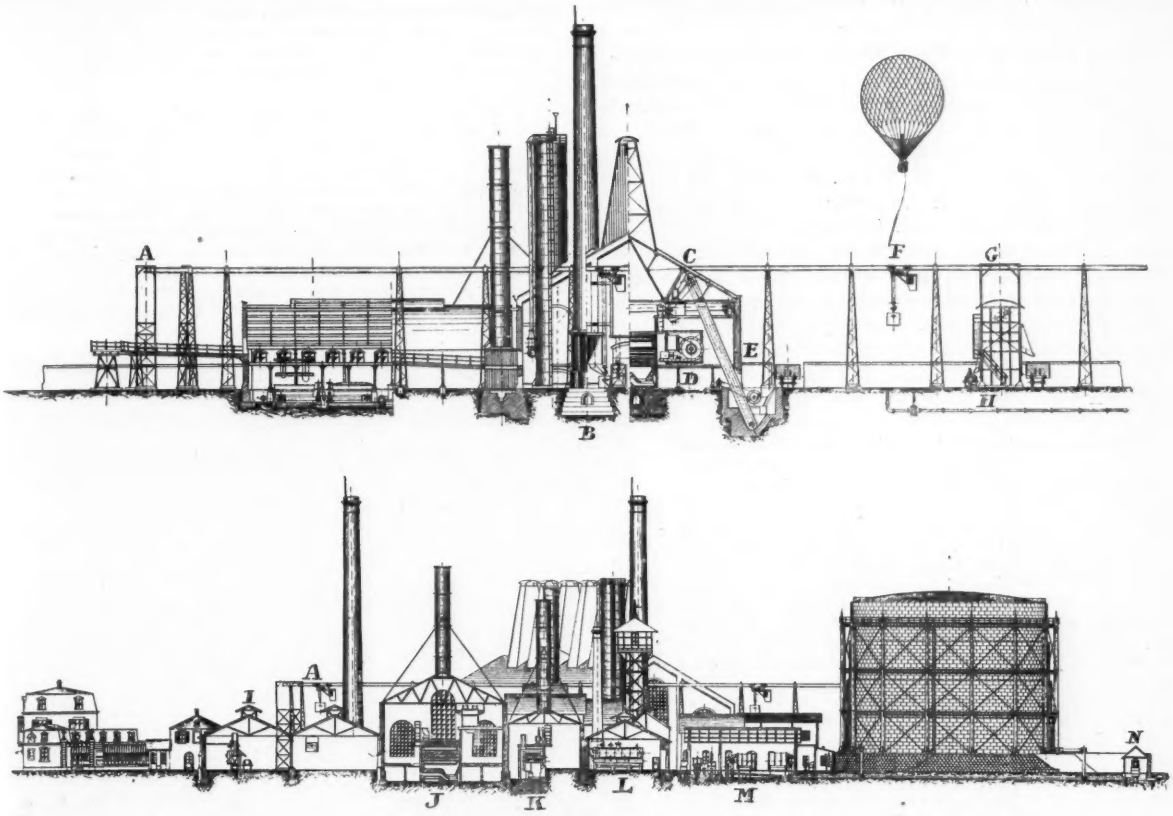
into to this effect with the Strasburg Municipality on Dec. 25, 1908. The gas is sent under a pressure of 40 inches of water from the farther side of the bridge by means of a rotary pump of American make. At a certain point, where the pipe divides into two branches which run into the city, there has been fitted up a governor which reduces the pressure throughout the district to the normal.

In order to present in a concise form the results of all the Company's efforts to extend their business, M. Kern gives a table showing the consumption of gas for various purposes in a period of nineteen years; and some of the figures, in cubic metres (1 cubic metre = 35·3 cubic feet), are reproduced in the following table:—

Years.	Private Lighting.	Heating and Cooking.	Motive Power.	Public Lighting.	Total Production.
1889–90	3,482,560	28,591	249,057	816,842	5,585,970
1894–95	3,517,328	395,851	705,317	1,035,694	7,079,780
1899–00	3,786,970	3,480,294	568,209	1,550,087	11,329,750
1900–01	3,967,924	4,133,038	546,907	1,623,462	12,117,590
1901–02	3,618,062	4,919,715	476,128	1,411,853	12,453,710
1902–03	3,549,786	5,360,394	440,985	1,412,889	12,875,900
1903–04	3,469,849	5,826,939	393,203	1,461,543	13,082,090
1904–05	3,553,899	6,446,939	332,327	1,525,653	14,144,660
1905–06	3,681,203	7,159,686	346,881	1,687,817	15,291,644
1906–07	3,584,034	7,902,693	293,730	1,836,470	16,298,794
1907–08	3,391,489	8,674,441	257,638	1,883,006	17,094,795

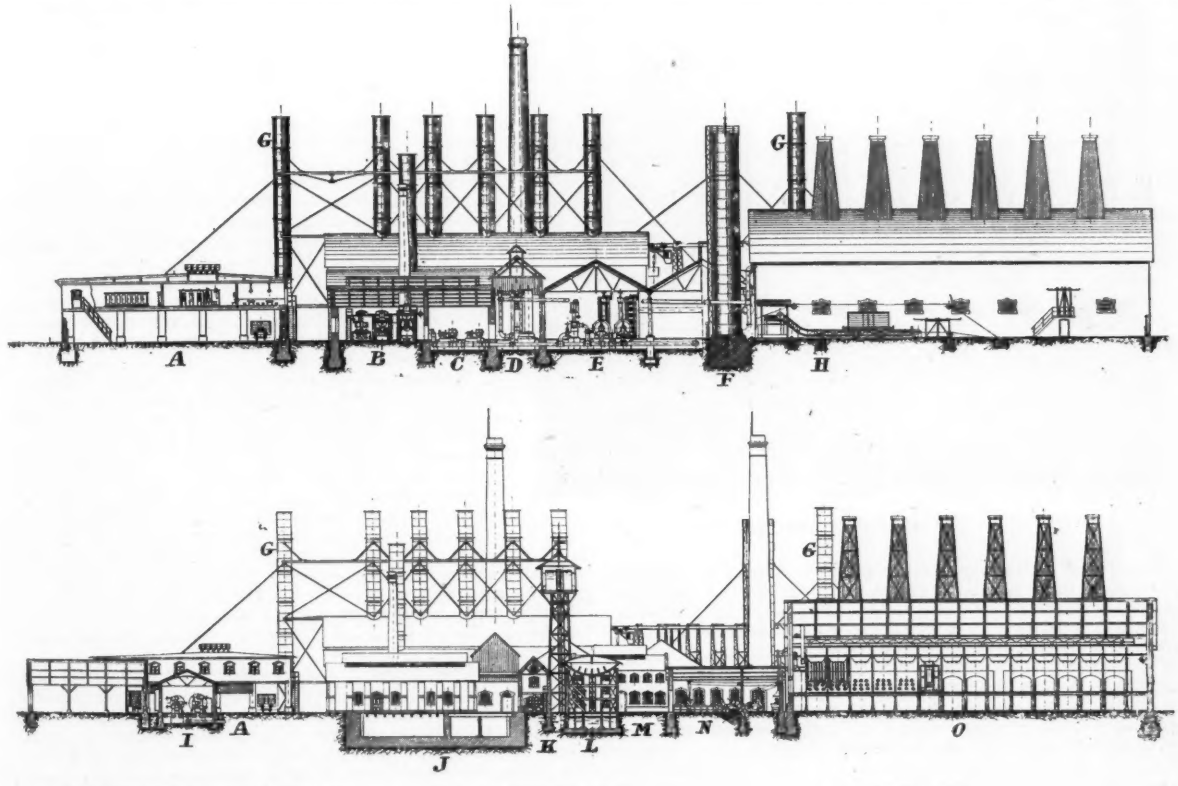
These figures show that the use of gas for heating and cooking purposes has extended in a most unexpected manner; while gas has kept its position as an illuminant, notwithstanding the occurrence of certain circumstances which were calculated to adversely affect it. For instance, in 1892, Berlin time was adopted throughout the empire. This retarded the lighting-up time by half-an-hour in Alsace, and consequently was detrimental to the consumption of gas. On the 100,000 burners in use by the consumers, this loss may be estimated at close upon 90,000 cubic feet. In 1895, a law came into force under which shops were closed after midday on Sundays. This had the effect of cutting out sixty days' gas consumption by the shopkeepers of the city. The introduction of the Welsbach burner for both public and private lighting in 1900 should have resulted, owing to its economy, in a reduction of 50 per cent. in the consumption of gas for lighting; but this is not apparent from the figures in the table. The falling off was doubtless compensated for by the extension of lighting installations brought about by the superiority of the incandescent over the old system. Reduced to the consumption per private burner, however, the difference is seen at once. From 1880 to 1895, the average consumption per burner was 2600 cubic feet per annum; in 1897, 3650 cubic feet; in 1899, 4275 cubic feet; in 1900, 4000 cubic feet; but in 1901, only 2330 cubic feet. Finally, in 1906, most of the shopkeepers agreed to close at eight o'clock at night. However, notwithstanding these unexpected occurrences, no very serious effect was produced upon the consumption of gas; nor is any feared in the future. Gas has so many uses, and is adaptable to so many requirements, that it will continue to prosper, to the great benefit of humanity.

It now only remains to say of M. Gaston Kern's interesting book, that its two closing chapters are devoted to the arrangements made by the Company for the comfort and welfare of the employees, and for providing for their needs in sickness and old age; and to those for furnishing the gas needed by the aeronauts. In the latter connection, it may be mentioned that one of the 48 ascents which took place in 1908 was made on Sept. 24 by Captain Lohmüller, accompanied by schoolboys—Adolphe and Raoul Kern, respectively sixteen and fourteen years of age—with the object of taking a bird's-eye photograph of the works. The weather was favourable, and a good picture was the result, as testified by the reproduction which appears on the last page but one of the book. In the "JOURNAL" for the 4th inst., we gave plans of the Strasburg gas-works as they were from 1858 to 1861, and from the latter year to 1870. We now supplement them by reproducing a plan, on a larger sale, showing the works in practically their present condition, and also four sectional drawings of the buildings and plant.



A. Overhead Coke Convey
B. New Retort-House.
C. Coal Conveyor.
D. Fiddes-Aldridge Machine.
E. Coa Breaker.
F. Coke Transporter.
G. Coke Breaking and Sorting Shed.
H. Ten-Inch Main for Filling Balloons.
I. Coke Shed with Breaker.
J. Original Retort-House (showing Old Settings).
K. Recuperative Settings.
L. Boiler.
M. Meter and Governor House.
N. New Outlet Governor.

LONGITUDINAL SECTIONS THROUGH THE WORKS—SOUTH TO NORTH.



A. Coal Store (Workmen's Rooms above).
B. Boilers.
C. Exhauster
D. Condensers
E. Pelouze and "Standard" Scrubbers.
F. Condensation Tower.
G. Coke-Quenching Tower.
H. Coal Conveyor.
I. Station Meters.
J. Liquor Wells.
K. Water Tower.
L. Tar Tanks.
M. Sulphate House.
N. Smithy.
O. New Retort-House.

SECTIONS THROUGH THE WORKS—EAST TO WEST.

A VISIT TO COTTAGE LANE METER WORKS

By the London and Southern District Junior Gas Association.

The members of the Association last week had an opportunity —of which a large number availed themselves—of visiting the old-established meter works in Cottage Lane, City Road, E.C., with which the name of Parkinson has for very many years been connected. Some time ago, Messrs. Parkinson and Co. joined forces with Messrs. W. & B. Cowan; and since then the style of the firm has been Messrs. Parkinson and W. & B. Cowan, Limited. To avoid any chance of overcrowding, and consequent missing of points by the visitors, it was arranged that the inspection should be made by two parties, on Wednesday and Thursday afternoon respectively. On the former day the attendance was about 25, which number was increased to some 35 on the Thursday. The President of the Association (Mr. W. J. Liberty) was present on both days.

Before proceeding to give an indication of the works as they are now, it will be of interest to say a few words about the early history of the firm. The business was established in the year 1812 by two brothers, Samuel and John Crosley; and with them was associated Mr. Clegg, the original inventor of the wet meter. The meter, however, as Mr. Clegg invented it was not practical until it was taken in hand by Mr. Samuel Crosley, who turned it into a commercial success. The two brothers Crosley died in 1847; and Mr. W. Parkinson (the father of Mr. W. C. Parkinson, the present head of the business) succeeded them. Mr. W. Parkinson died in 1854; but his son was not then of age, and so did not take possession until 1862. There was thus an interregnum of eight years, during which time there were one or two managers, who kept the business going without any break. Mr. W. C. Parkinson himself carried on the works until about ten years ago, when the firm joined Messrs. W. & B. Cowan, and formed the present Company, of which Mr. W. C. Parkinson's son, Mr. W. W. Parkinson, is now a Director with him. It will thus be seen that Cottage Lane is the original home of the wet gas-meter. About twenty years back, it should be mentioned, Mr. Parkinson acquired a Birmingham factory by purchasing Bent and Son's business.

Engineers' Shop.

From small beginnings, the Cottage Lane Works have steadily progressed, until now they cover a very large ground space, and give employment to no less than 300 men, one at least of whom has been in the service of the firm for a period of no less than 48 years. In fact, it is, in these days, when so much is made of the young man, extremely pleasing to enter a works where so many old servants are employed as is the case at Cottage Lane. In the large new brass shop—of which more anon—the statement was made by the genial foreman that nearly every man there had been married while with the firm—that is, they had been brought in as lads and had stayed on as men. Some of them even have now their sons engaged in the shop. Everywhere order, thoroughness, and a high personal standard are to be observed in the men. In certain desirable respects firm supervision is exercised, from which the employees have no doubt derived great benefit. Gambling is absolutely forbidden; and so is money-lending—one of the greatest possible curses, where it exists, in workshops. Any political talk is as far as possible prevented. From good men and good machinery, good work would naturally be expected; and an inspection of the works (apart from the firm's world-wide reputation) is sufficient to convince one that the two conditions are present, and that the result which would be looked for from them is actually attained.

On arrival, the visitors were promptly taken in hand by Messrs. W. C. Parkinson, W. W. Parkinson, and W. Cheshire (Directors), who, in conducting the party round the factory, were assisted by Messrs. A. E. Hayes, W. J. Wright, W. E. Toynton, and P. G. Parkinson, Mr. F. R. Smith being away from England on a short holiday. The inspection was commenced at the engineer's and erecting shop—the latter a very high building about 50 feet long and 30 feet wide, excellently lighted by glass in the roof. The members were fortunate in being able to see in course of construction various parts of a 100,000 cubic feet per hour square station meter. Cylindrical meters were also seen finished and in

Tinsmiths' Shops.

parts, as well as retort-house governors and other of the firm's specialities. The machinery in the engineer's shop is driven by a 50 H.P. steam-engine, and includes a very large (one of the biggest in the country, it is said) side-planing or edge-planing machine. There is also an original type of edge-turning and facing machine, which was made by the firm themselves to do work that was previously performed by hand. With the machine, it is possible to do in a few hours what used to take two men several days to accomplish far less efficiently. It has been said that this useful appliance was "home made;" and this, it may be added, is a feature of many of the machines about the factory—which shows both the ingenuity possessed by the firm and their employees and the wide range of work that can be carried out in the shops. There are in the works three power tin-stamping machines. Before leaving the engineer's shop, the foreman pointed with pardonable pride to the Babcock and Wilcox boiler, which has been installed since 1897, and has never yet drawn forth a bad report from the inspector.

Passing through the tin-plate store, the cutting out and stamping shop was reached; and here, among the numerous appliances at work, was seen a circle cutting and edging machine, made by one of the firm's own men some forty or fifty years ago. Most of the brass castings required are made on the works; and there are in the foundry two furnaces. They also make all their own solder; the mixture of tin and lead being run into open moulds. Hereabouts a demonstration was given of the working of an ingenious little machine for the casting of valve-gratings under pressure. On the top floor of one of the buildings is the corner where the Persian sheepskins—the only leather used—are first cut out, and examined for the absence of holes in a dark room; and close by the leathers are fitted to the diaphragm rims.

The three tin shops—the top, middle, and bottom tin shops, respectively—were next visited. These are very roomy and excellently lighted shops. In the first of them, the repair work is carried out. All meters when they come in are tested; and, in fact, the work entailed in repairing a meter seems to be almost as much as that which is involved in making a new one. For all the tinmen's fires, it may be noted, gas is used. The ordinary gas supply is governed down to a pressure of 1½ inches; and at the point of ignition air under a pressure of 20 inches is admitted. One of the reasons why gas is employed in this connection is that about twelve years ago there was a fire in the works which was put down to the charcoal furnaces that were then used. And, in

addition to this danger, charcoal is, of course, a dirty heating medium as compared with gas. In the portion of the factory devoted to new work, a feature of interest was a table which had been laid out with automatic meters in various stages of construction. First all the parts were shown; and in succeeding sections meters were seen with gradually more and more parts fitted, and in each case the remaining parts lying in front. To the uninitiated, it was perhaps somewhat surprising to learn that an ordinary dry meter is made up of about 54 separately named parts, and that, as many of these are duplicated, there are over a hundred parts in a finished meter of this type. In a slot-meter, of course, there would be many more. All the meters being made at the time of the visit were of the dry pattern; large numbers of wet meters in both tin and cast iron cases being made at their Birmingham factory. The bottom tin shop is utilized for the carrying out of large work. For raising and lowering goods to and from the different floors, there is both a hydraulic and a hand lift.

Where the Large Work is Done.

An important branch of the works is the testing of meters; and for this elaborate provision is made. Preliminary proving of the meters is accomplished with gas; a pressure of not more than about 1 inch being employed before the meter is boxed up. With reference to the finished meters, it has of late years been found necessary to increase the pressure of gas for soundness. Formerly, about 6 inches was regarded as sufficient; but since the introduction of the prepayment meter, it has been thought better to make doubly sure by raising the pressure to a maximum of (say) 18 inches. The final air-test is carried out with air under a pressure of 5-10ths. The explanation given by Mr. Donald Cheshire of the action of the Beasley recording gas calorimeter (which was described and illustrated in the "JOURNALS," for Sept. 21, 1909, Oct. 27, 1908, and July 30, 1907) was followed with great interest by members. They subsequently visited the paint shop and stores, the packing shed, the water-meter testing shop (the firm have their special make of water-meter, it may be remarked, as well as of gas-meters), and the carpenter's shop. On the way, they learnt that the japanning required is done on the premises in a gas-heated oven 5 feet by 4 feet.

This brought the party to the final shop, to which reference was made at the commencement of our notice—namely, the brass work and index shop. This is a big building which was only put up a few months ago, and for the accommodation of which several cottages had to be demolished. Previously, the work which is done here was carried out under far less satisfactory conditions in another part of the factory. The new roof-lighted shop contains at least forty machine tools, and provides work for some sixty employees, all of whom are on piece-work with the exception of three boys. Many of the machines are of an intricate nature; and one of them at least is quite automatic in its action. It merely needs attention at the start and at the finish of its operation—which is the cutting of sixty teeth on twenty-four wheels at the same time. Thus a man who has a machine of his own to look after can also give the trifling attention to this one which it requires. Other of the machines are but little less automatic in their action than this. Members were able to see screw-cutting being done by hand—a useful craft which seems, however, destined to drop gradually out of use owing to increased introduction of machines. The machinery in this shop includes a Keith compressor used for the high-pressure gas with which the place is supplied for lighting, blowpipes, &c. There are 60 Keith inverted 100-candle power gas-lamps on this system; but lights off the ordinary gas-main are also provided, in case of the high-pressure plant being at any time brought to a standstill. The Keith installation is, it was generally admitted, an admirable illustration of what the lighting of a factory should be. In addition to the high-pressure gas soldering stoves, there is a lacquering stove connected to the same system; and in the foreman's office and store there is an effective little high-pressure heating stove. The parts made in the shop are stored in hundreds of small iron bins, and handed to the tin-shop men as required. Much interest was displayed in a Crosley rain-gauge which was seen working (with the aid of a jug of water) in the store.

Interior of the Brasswork and Index Shop.

At the close of the inspection, the party repaired to the offices, where they sat down to meat tea, on the invitation of the firm—the chair being occupied by Mr. W. C. Parkinson. At the conclusion of this welcome item of the programme, on Thursday,

The PRESIDENT (Mr. W. J. Liberty) said it was an extreme pleasure to him to find himself at these works that day, as he had known Mr. Parkinson for many years. Some fourteen years ago, he was there with the original London Junior Gas Association, when the visit was paid under the presidency of Mr. G. P. Lewis, then of the Crystal Palace Gas Company; but he did not think he would now recognize the works. The firm were gradually absorbing the whole of the north side of Cottage Lane. The cottages were disappearing; and the works were growing. They must attribute this greatly to the introduction of the slot-meter. At the time of the previous visit, this appliance was being very much talked about, but not much used. At the present day, however, it was a most important branch of manufacture. Perhaps there was nothing much more interesting than meter making. It reminded them of clock making, when they came to look at the numerous parts which had to be so carefully and accurately made to avoid the possibility of any mistake. Once upon a time there were no meters; and it was to that great and indefatigable man Clegg, the Engineer of the Chartered Gas Company, that they owed the gas-meter. Most of those present had had experience of what was called the "rental department." The origin of this was that, there being no meter on which to base the charge to the consumer, the rates for gas were fixed upon a rental per burner. He quoted the charges made in 1820 and 1821 in Wandsworth and Bodmin. The rates in Wandsworth were, per annum, for a No. 1 argand: Dusk till 9 p.m., £2 10s.; till 10 p.m., £2 16s.; till 11 p.m., £3 4s.; all night, £4 8s. If burnt on Sundays, a sixth extra. One jet for hall or passages, 4-inch flame, £1 10s. At Bodmin, the prices from dusk till 9 p.m. ranged from £1 for a single jet to £3 10s. for a 16-hole argand, with later consumptions in proportion; one hour extra being allowed on Saturday nights, and a reduction on £2 2s. lights and over being made for four lights and upwards. There was also the same stipulation as to one-sixth extra charge being made in the event of gas being used on Sundays; and there were various other conditions. About 1820, he continued, Clegg was trying to lift the gas industry out of the rut into which it had fallen, after the enthusiasm engendered by Winsor and Murdock had died down. He was the Livesey of those early days, and, with untiring energy and pluck, came forward to put an end to this peculiar condition of things. He invented, among other things, two kinds of useful mechanism in connection with the gas industry. One was a tap for automatically shutting off the gas when a flame became accidentally extinguished; and the second was an instrument which was called "Clegg's self-acting gauge."

by the introduction of which justice was done to both consumer and seller. This machine, it was stated, "measured and registered, in the absence of the observer, the quantity of gas delivered by any pipe connected with the gas-light main." It occupied a space of about 2 feet by 1 foot. This was really the first gas-meter; but though it was made a scientific success, it was not a commercial success. It was left to Mr. Clegg to come down to Cottage Lane, the home of the gas-meter industry, and submit the instrument to Mr. Samuel Crosley, who put it on the market, and secured its adoption by the gas companies. This it was that made their visit that day so peculiarly interesting. He felt they were right in the midst of the home of the gas-meter industry. If they looked down the list of their patrons, they would find the honoured name of Charles Hunt. When Mr. Hunt went from Yarmouth to London, he came to Cottage Lane, where he worked for three years. Then he went to the old London Company, and from there to Birmingham. Thus the place where they were assembled had a good record, having been in touch with the leaders of the industry. The visitors had been much engrossed in the various things on view. They had seen many appliances besides gas-meters, which showed that the premises were so well equipped with plant that they could turn out a great variety of goods. One point he had noticed about the works was a Suggestion Box, which held out inducement, in the shape of rewards, for useful thought. Payments of 5s. to £5 were made according to the value of the suggestion; and the firm had in this way paid many sums to the workmen. This showed the nice relationship that existed between the employees and the heads of the establishment. Well, he hoped he might be alive in another fourteen years' time to pay a further visit to the works. If so, he would expect to see the whole of the north side of Cottage Lane absorbed by the firm. The members greatly appreciated the kindness that had been shown them on this occasion.

Mr. E. G. Stewart (Fulham) proposed a hearty vote of thanks to Mr. Parkinson and the other gentlemen who had shown them round, and to the firm for the invitation to visit the works and the hospitality they had extended to the members. He remarked that he was surprised at the number of men employed, and had been much struck with the order and cleanliness everywhere exhibited. It was evident the greatest sympathy existed between the Directors and the employees.

Mr. F. Cauldwell (Kilburn) seconded, and expressed admiration for the ingenuity displayed upon the works. Specially admirable features were, he considered, the lighting and machinery in the brass shop.

The resolution having been put and carried with applause,

Mr. W. C. Parkinson returned thanks on behalf of himself and his co-Directors, Mr. W. Cheshire and Mr. W. W. Parkinson. He said he was glad to find that the members of the Association had appreciated and understood a good deal of what they had seen that afternoon, and also that they had been pleased with what he might term the "finale" in connection with it. This was not a function that very often took place at the works. There was a tradition that something of the sort was done when the first square station meter was constructed; but as this was years even before he had anything to do with the factory, it might or might not be a fact, for all he could say. Seeing that he had been connected with the place for over fifty years, he could look back a long time. The gas industry seemed to be about a hundred years old. Things were rather indefinite with respect to that time; but he believed it was just over a hundred years ago that Mr. Clegg put up the first complete installation to supply gas—not to sell it to the public, but to furnish it to a mill in Yorkshire. It was very soon after this—about the year 1812, he thought—that the old Chartered Gas Company started with their Brick Lane and Curtain Road Works, within half-a-mile of where they were now assembled. Things were very different now; and work which evidently passed well at that time (though there was some good work done even then) would not do to-day. As they had seen, it was necessary to do everything with an extreme amount of precision and accuracy, in order that the public might have confidence in the apparatus for measuring gas, and that the gas suppliers should be satisfied that they were getting a proper instrument for the work they required to be done. A great stimulus was given to this scientific accuracy of working by the passing of the Sales of Gas Act—now some forty or fifty years ago. It was one of the earliest Acts with which he had anything to do; and it was rather a curious enactment for the testing of gas-meters. Probably they knew very well that there were hundreds and thousands of meters that could not be tested in exact accordance with the terms of the Sales of Gas Act. This, however, did not matter. They were tested in a manner that the gas suppliers and consumers found satisfactory. The Act established a basis of scientific accuracy that had gone on increasing ever since. Mr. Crosley, the originator of the Cottage Lane business, had a great deal to do with the construction of the earliest gas-meters; although Mr. Clegg no doubt was the original inventor. Mr. Crosley put the thing into such a shape that it was able to be sold as a useful commercial instrument. He, however, seemed to have had some curious ideas about the gas industry, because on one occasion when he was urged to rebuild some of the workshops which were in a dilapidated condition, he said: "I do not see that there is any need to do it. I think the public will soon have as many gas-meters as they want." Thus he did not feel inclined to spend money on improving or extending the works. However, as years had passed, they had gone on, he ventured to say, improving all round. At any rate, this was what they desired to do. His own early education at an engineer's establishment, put it in his mind that this business ought to be conducted on a really scientific basis, and that the rule-of-thumb which prevailed fifty or sixty years ago should be altered. When he first came to the works, there was no steam-engine installed; and instead of a shop with sixty men working at lathes, he thought there were only about two lathes in the place. They had reached a better position now; and they had to look forward to still further advances in the future. The calorimeter which they had seen was an instance of new requirements, for gas nowadays was not nearly so much used for lighting in flat-flame burners as it used to be. Therefore engineers required to know the calorific value of their gas, and not merely the illuminating power. For incandescent lighting, as well as for stoves, it was heat that was wanted. This being so, the firm were endeavouring to provide the requisite instruments for ascertaining and for recording the heating value of gas. As he had already remarked, the business had grown from fairly small things to a rather large size. It was only about ten years ago that they joined Messrs. W. & B. Cowan in the formation of a big Company; and now their ramifications extended practically all over the world. They had factories in connection with their Company, not only in London (including large new works at Kennington), but in Birmingham (two), in Edinburgh, in Belfast, in Manchester, and even in Australia. He was very glad indeed to think that the members had been entertained by their visit, and that they had seen something of what was possible in the way of machinery for doing this class of work. He believed that they had not by a long way reached perfection, either in the direction of accuracy or of machinery for carrying on the work; and if the suggestion of the President came true, and the Association paid the works another visit in fourteen years' time, the firm would be able to show them what they had done in the meantime. He hoped they would have made as much advance as had been the case in the last fourteen years.

Among the papers to be read at the Surveyors' Institution during the session is one by Mr. Baldwin-Wiseman, on "The Conservation of our Water Resources."

At the meeting of the Manchester City Council on the 5th inst., the recommendation by the Finance Committee, that Mr. John Williams should be appointed City Treasurer, as notified in the "Journal" for the 4th inst. (p. 22), was adopted.

The "Pacific Gas and Electric Magazine" for November, which lately came to hand, contains the paper contributed to the American Gas Institute, at the last annual meeting, by Mr. E. C. Jones, the Engineer of the Gas Department of the Pacific Gas and Electric Company of San Francisco, who are the publishers of the magazine, on the subject of "The Development of Oil Gas in California." The plant is described and illustrated, and the process of making the gas explained. The author concludes that the future of oil gas depends largely upon the price of oil and the practice of economy in manufacture. He says the former may be regulated by a gas company owning their own source of supply of oil; while the latter rests in the hands of every conscientious worker in the gas industry. The contents of the magazine, which are of a varied character, include a biographical sketch of Mr. W. R. Eckard, the Consulting Engineer of the Pacific Company.

A lecture, on "The Circulation of Water in the Earth," was recently given by Professor Boyd Dawkins at Manchester University. He said there were in Nature two definite systems of water circulation—one above ground, due to the heat of the sun; and the other below ground, due to the heat of the earth. To the circulation of water below ground might be attributed some important effects, notably the equable flow of many rivers. A safe estimate of the amount of rainfall which found its way through the ground was about 10 inches in 35. Thus there were a number of wells in and around Manchester, some of which yielded as much as 600,000 gallons a day. They drew their supply from the water which percolated through the superficial gravel and sand in surrounding districts. Professor Dawkins outlined the water-bearing qualities of the various geological formations, and explained the difficulties presented by limestone and the advantages offered by chalk to those desirous of sinking a well.

According to the "Chemical Trade Journal," the Council of South Russian Iron-Works are agitating for Government protection of bye-products of the South Russian coking operations in the form of protective tariffs against foreign imports, and for special low railway freights for home products. At present the production of coke and recovery of the bye-products are carried on at various works in South Russia. Their total production of 25 per cent. ammoniacal liquor is about 350,000 poods (5645 tons), and of liquid coal tar about 850,000 poods (13,713 tons). Besides this, a certain quantity is obtained by the distillation of coal at some of the gas-works. Hitherto most of the liquor has been taken by the soda factories of South Russia; but there is now an excess in the supply, and the price has very seriously declined. Russia has few chemical factories capable of absorbing it, and they are rather in the Baltic district—*i.e.*, about 1500 versts (1000 miles) distant. Therefore, says the writer of the report accompanying the application for the Government aid, it would be better to utilize the ammoniacal liquor in the production of sulphate of ammonia for manure. Its price prevents its general use.

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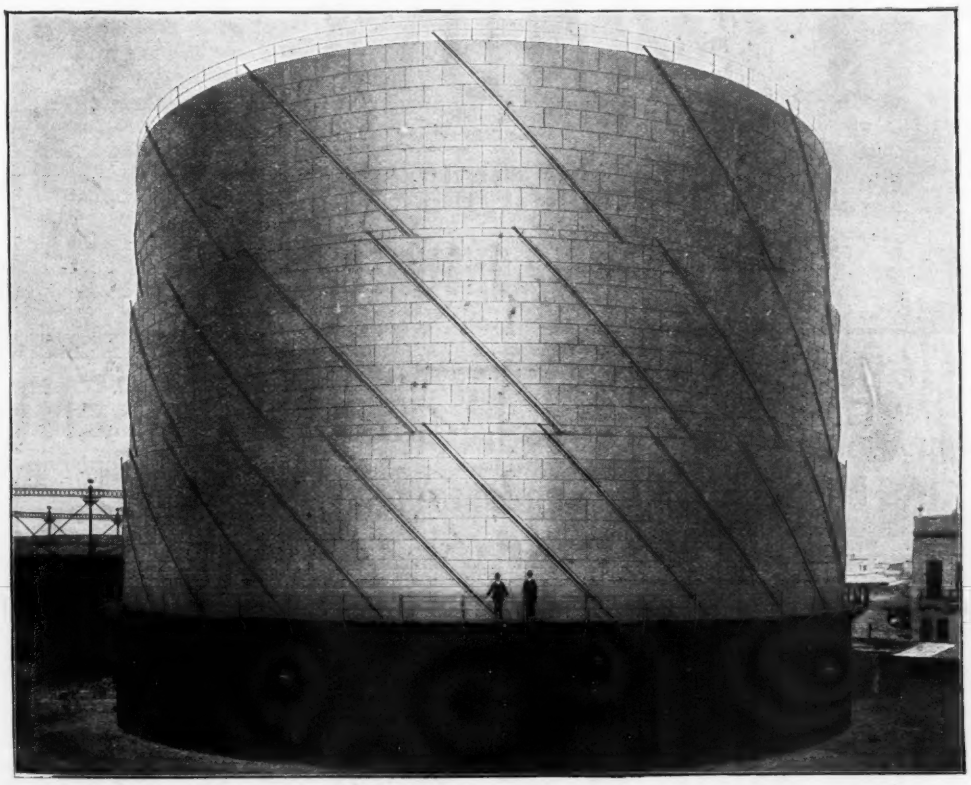

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A STERILE BORING IN THE INFERIOR OOLITE.

By William Phelps.

[Extracts from a Paper read before the Association of Water Engineers.]

The Wincanton Rural District Council, after being satisfied, on the advice of experts, that success was probable, commenced in April, 1908, to sink a boring for water at Stowell (Somersetshire), with a view to supplying the town of Templecombe, which, though small, has an important railway junction on the South-Western Railway.

The boring is executed entirely in the Lower Jurassic formation, commencing in the Upper Fuller's-earth clay, and passing downwards successively through the Fuller's-earth rock, Lower Fuller's-earth clay, and Inferior Oolite, into the Midford sands.

The author's report, which formed the principal basis of an application to the Local Government Board for a loan, advised as follows.

(1) That while the Fuller's-earth rock would probably yield some water, it was not to be relied upon for the permanent supply which he expected to obtain from the Inferior Oolite, or, failing this, the Midford sands.

(2) That the thickness of the Fuller's-earth and Oolite would probably be found to considerably exceed that estimated for the locality by various observers, and recorded in the Memoirs of the Geological Survey, and that the Oolite would probably show 180 feet thickness as against 100 feet so recorded.

The results were as follows: A dug well was sunk 89 feet through very hard clay, and lined with 6-inch radial well bricks laid from the top on a sinking curb of cast iron. At this depth (89 feet) a trickle of water was met with, and owing chiefly to the very slow progress, and the almost impossible task of excavating the hard material by hand wedges, it was eventually decided to resort to boring. The boring proceeded through the remainder of the hard upper clay until the layers of Fuller's-earth rock were reached. As it was now unnecessary to keep the well dry, the water gradually rose; and after a few days of boring it was standing within 25 feet of the surface, several beds of rock being cut in the interval.

The probability of some water being obtained from these rock beds had always been anticipated; but it had been decided that a permanent supply from this depth was not to be relied on. It was nevertheless thought advisable at this point to roughly test the quantity of water then being yielded by the Fuller's-earth rock. After some hours' pumping, the water-level in the well was lowered to 70 feet from the surface; and as the pump, which was then throwing 650 gallons per hour, would not further lower the level, the test was abandoned for the time being—an actual yield of 15,000 gallons per day having been considered as proved, while the author reported to the Council that, in his opinion, a yield of at least 25,000 gallons a day could be obtained from this source, if necessary.

Boring was then resumed, and proceeded until the contract depth of 350 feet had been reached; the only fact of note being that, instead of the Inferior Oolite rock being encountered at 245 feet as expected, the cores showed hard clay very similar to the Fuller's-earth clay, but gradually lightening in colour, and much streaked with veins of calcite up to 332 feet.

At 290 feet a thin bed of laminated calcite was cut; the clay for 2 feet below this being soft and wet, but gradually resuming its normal hard marly nature. With a view to prevent trouble from the slipping of this soft clay, and also with a view to separate the upper water from any which might now be obtained at the lower levels, 8¼-inch butt-jointed steel tubes were fixed in the boring, without any trouble, to 305 feet; and boring was continued through the tubes (8 inches in diameter) to 350 feet.

At this point, the contract depth having been reached, it was decided to test the yield of the boring, although the standing water-level in the tubes showed little promise of a successful result. A tube pump was fixed and started to work; but a few minutes' pumping sufficed to show that the yield was practically *nil*. It was then decided to proceed a further 100 feet, to 450 feet (at about which point it was hoped that the Midford sands would be struck). This was done The whole of the cutting to this point was in hard Oolite rock, which, however, showed encouraging signs of fissures or joints. But the rest-level observations still indicated absence of yield; and after some hesitation the Committee were induced to sanction further boring to 550 feet before testing was again carried out. After proceeding for a further 5 feet, to 455 feet, the cores showed obvious signs of a change to sands, which change was hailed by all concerned as the probable harbinger of a successful termination to the enterprise. At 460 feet the rest-level test showed promise of a small yield of water, which further elevated probability almost to certainty; the sand now being so friable that several feet of cores were lost by grinding-up in the process of gripping. From 470 feet, however, beds of stone varying from 6 to 15 inches thick were interstratified with hard sand, and the latter gradually assumed a marly character; the rest-level showing no improvement to the end.

It was realized that, although the standing pressure in the tube might not be sufficient to force out the *débris* which, under the shot-drilling system of boring, must of necessity be forced into the pores of the strata surrounding a boring, it was still possible that if the water were lowered in the boring so as to create an external head of some 300 to 400 feet, a good yield might possibly be induced by continuous pumping. The tube pump was therefore lowered to 350 feet from the surface and pumping commenced; but a short period sufficed to show that the immediate yield was less than 100 gallons per hour. After pumping continuously for 34 hours without apparent increase, it was decided that the boring should be abandoned, as showing too little promise to warrant any further outlay. The yield of the Fuller's-earth rock was afterwards proved at 25,000 gallons per day; but it was eventually decided that its use would not be justified in the circumstances, for various reasons.

[An appendix to the paper contained some geological and ethnological notes by Mr. John Pringle on the boring referred to by the author.]

Discussion.

Mr. William Whitaker (Croydon) said this was a case where the adviser had been justified in recommending the work. He (Mr. Whitaker) would probably have recommended it himself if he had been consulted. It was a most likely thing that water would have been obtained by sinking a well, on the particular site chosen, to the water-bearing beds. But all knew that Nature was an uncertain kind of party. She would show one a long line of outcrop beds that looked extremely porous and helpful from a water engineer's point of view; and then in their underground course, where they could not be seen for a few miles, the beds would change their character, either by the weight of the superincumbent formation or by lithological change. Fine sands became finer, and fine clays became more compact; and where one might have expected to obtain a good supply, only a small one was got. Something of this sort seemed to have happened here, from what Mr. Phelps had told them: Certain beds that were not clay in one part changed, and became clay. He was afraid this was the only explanation he could see—that some change occurred in the character of the beds in their course underground from the escarpment. He noticed that the latter part of the work was done by boring, owing to some difficulties in sinking the shaft. It occurred to him that if these difficulties had been got over, and the shaft could have been taken deeper, better results might have followed. Again they must not let failures overpower them, because, although there was failure in this one particular spot, it was possible enough that not so very far off, a boring in a somewhat similar position might give a successful result. He hoped this boring would not be closed up, but that it would be open for inspection for some little time.

Mr. Henry Preston, F.G.S. (Grantham), said this was a most interesting case of a boring which had failed to yield water; but he was rather disposed to think there were means of explaining the failure, although possibly if one had been asked before the boring had been made, an opinion would have been given favourable to a supply. If the boring had been in Lincolnshire, he would have said at once that the position was not sufficiently removed from the outcrop for there to be much chance of water. The limestone rocks in the author's case were porous, and the quantity of water entering them was so small that it would all get away towards the east. Hence he should not expect to find a good supply of water in the Oolite at the boring. Even if the limestone had received the whole of the water falling on the outcrop, it would probably have passed through the rock, and into the Midford Sands beneath. In Lincolnshire, they had similar

rocks, of similar age, and similarly deposited—that was, the water-bearing rock of Lincolnshire limestone, which overlays the beds of Northampton Sands, and which rested on the Upper Lias clay. Above the limestone rock were dense clays again, just in similar manner to what they had in the case described by the author. In Lincolnshire, these rocks dipped, and thinned out slowly as they were proved eastward; and, as they got under deeper and deeper cover, they also got denser. Consequently, when they wished to put down a boring, in the east of the county, it was often necessary to go right through the limestone rocks, and into the Lias clay. Sometimes even then they failed to find water; and he had generally come to the conclusion that it was due to the density of the strata, and the tool having failed to find a fissure in the rocks. Several cases of a striking character had come to his notice within the last eighteen months; and he gave particulars of them.

Mr. A. B. E. Blackburn (Sunderland and South Shields Water Company) said he thought Mr. Preston had hit on the real reason for the failure of the boring. It ought to have been on the west side of the fault. There was such a small outcrop of the Midford Sands on the east side of the fault that he did not see how the author could have expected to obtain any quantity of water from a boring put down at the place selected for it. He would like to ask whether Mr. Phelps had full knowledge of this fault and of its throw before he started the boring. Also how far he bored into the sands, and the total thickness of the sands From what he (Mr. Blackburn) could see, the surface of the sands was simply scratched—the author did not go nearly to the bottom of them; and then, again, the pumps were only lowered 310 feet, whereas the borehole was nearly 350 feet in depth. He did not see how the borehole could be expected to yield any quantity of water when the pumps were not lowered down anywhere near the sands, which presumably would be the water-bearing strata.

Mr. Harry W. Taylor (Newcastle-on-Tyne) said he quite agreed with Mr. Whitaker—that it called for considerable courage on the part of an engineer to bring a failure before the members of an Association. Nevertheless failures were frequently very instructive. An instance to which he might refer was somewhat similar to the one dealt with in the paper. Mr. Blackburn pointed out that he thought the valley on the west would probably prevent the flow of the water underground to the borehole, and that was the cause, to a certain extent, of the failure in the instance with which he was connected, near the Forest of Dean, Gloucestershire. But in that case it was not caused by a fault, but by an anti-cline—the boring having a large gathering-ground on the west of a porous stratum into which the rain soaked. Their boring was unfortunately on the east side of the anticline, just as Mr. Phelps's boring was on the east side of the fault. The result was abandonment. He should like to add that it showed the necessity, before a borehole was commenced, of a most exhaustive examination being made of the neighbourhood, and more particularly of the ground lying between the outcrop and the site of the proposed boring. Money spent in obtaining the advice of a thoroughly competent geologist was, he was certain, money well spent.

Mr. H. Ashton Hill (South Staffordshire Water-Works Company) said one point that had not been referred to was the distance from the outcrop. It was about four miles. The boring, as had been pointed out, was more clay than rock; and the conditions showed that it was very doubtful whether much water could be obtained there. He did not know about this outlying rock. One forgot, when not working in this formation, whether it was of a dense character or very porous. As had been pointed out, it was a pity the borehole had been stopped in water-bearing strata. He (Mr. Hill) always, as Mr. Preston did, went down into the impervious strata. When he made a boring (say) 500 or 600 feet, he took care to continue it through the pervious into the impervious strata.

Mr. Percy Griffith (Westminster) said he should like, having shared Mr. Phelps's experience of a boring which proved a failure, to say a word upon this point, and to carry the argument a little farther than it had been carried by previous speakers. His own impression was, with regard to borings involving a geological, and therefore somewhat speculative, element, that it was the duty of engineers to exchange their experience and views. He thought, moreover, that they ought to exchange their experiences of failures more definitely and more regularly even than experiences of their successes, not only because by this means they might, and probably would, save other engineers from experiencing similar failures, but in the public interest, because it was their duty, as engineers, to protect the interests of their employers and clients, and to prevent them wasting money unnecessarily. Therefore, on these two grounds, he urged that it was their duty to make a point of revealing cases of failures of this character. Of course, it was unlikely that anyone present would meet with exactly the same conditions that Mr. Phelps had described. But one never knew when one might have some problem to solve in which the data supplied by the author might come in very useful; and, in such an event, the paper and the discussion would no doubt be of great value. From this point of view, they owed Mr. Phelps gratitude for the facts that he had stated, though for the moment they were not able to make full use of them.

Dr. H. Lapworth (Derwent Valley Water-Works) said the author stated in his paper that he found the rock as exposed on the outcrop—the Inferior Oolite rock—more sandy than was shown in the boring; but if one examined the section of the boring submitted by the author, the rock looked so hopeless as a water-bearing material that it would have been very interesting if he had given them more detailed particulars of the exposures of these actual beds that he made on the ground. Another point—touched upon by Mr. Preston—was the course of the springs. When they had got a set of springs appearing on the outcrop, it should have been a warning that the rock was not very porous, or that there was some phenomenon intercepting the water on its way to the well. This led him at once to the obvious point that the Midford Sands seemed to be the only promising material. But here again—as Mr. Preston and Mr. Blackburn said—they had the outcrop cut off by a fault, so that there was the merest narrow strip exposed as a catchment area just below the escarpment. Another point threw some doubt upon the plan shown. At the left-hand side, they had the Lower Fuller's-earth clay, at the left was the fault; and if the outcrop of this bed was followed from the bottom towards the middle of the plan, it would be found that it cropped over the Inferior Oolite until it met the fault, where it was actually in contact with the Midford Sands. This phenomenon was only possible under two explanations—one was that there was much unconformity between the Lower Fuller's-earth clay and the sands, an unconformity in which they had the whole of the Oolite rock cut out in that short distance; or there was a fault running between the Inferior Oolite and the Midford Sands. Whichever it was, it showed that the main outcrop of the Midford Sands to the west of the plan was at a very low level—a level which made it impossible to feed the well with water.

Mr. Phelps, in reply, said he almost expected every speaker to grasp the fault, as ground for criticism. But there was a fact he ought to have mentioned. Where they saw a leg of Inferior Oolite running away to the north-west, not only the Inferior Oolite but the sands were exposed with a considerable outcrop at an elevation of 500 feet above Ordnance datum, or about 200 feet above the surface level of the boring. Had he plotted the section from the site of the well right through to the leg in the north-west, they would have seen no fault, and no valley on the west. They might have got a little depression, but very little, and they would have the section right up to that point, with almost a smooth inclination. It was perfectly obvious that he did not want to hide anything; if he had desired to do so, he should have drawn his section differently. He considered, independently of this, that the Inferior Oolite lying between the fault and the Fuller's-earth clay should have gathered quite enough water to produce all they wanted. With regard to continuing the shaft farther down instead of boring, it was intended to go down into the Fuller's-earth rock with the shaft; but as the upper clay got so hard that they could scarcely move it with wedges, the Contractor begged to be allowed to start boring, and the Committee sanctioned it. They even now looked upon the Fuller's-earth rock as a possible source of supply. Mr. Preston had referred to the water draining away east. As the bottom of the borehole was 200 feet below Ordnance datum, he did not see how the water could possibly pass the borehole as suggested. The Oolite rock was cut just above Ordnance datum, and where they got sands they were below Ordnance datum; so that he did not see how the water could have passed it. The discussion had confirmed his original idea as to the cause of the failure—that the lithological changes in the strata were responsible. Dr. Lapworth said he would like to have

more details of the exposure. He (Mr. Phelps) examined the whole of the outcrop. They had Oolite rock which on the surface was always more or less fissured right away through the outcrop. On the surface there was quite a big thickness of open fissured rock which looked encouraging. But there was not the same opportunity of examining the Midford Sands; he had to rely very much on the Oolitic rock. When they got down to this formation in the boring, they found they had about 100 feet of clay where they would naturally have expected rock. Mr. Blackburn thought they only "scratched" the sands. They went into them 100 feet; and he had explained why they did not go farther. Mr. Ashton Hill had spoken about a distance of four miles from the boring to the outcrop. There was a little misapprehension. It was about one mile from the boring to the beginning of the Inferior Oolite outcrop.

GLARE: ITS CAUSES AND EFFECTS.

By Dr. J. Herbert Parsons, F.R.C.S.

The following are extracts from a paper read at the Meeting of the Illuminating Engineering Society, at the Royal Society of Arts, on Tuesday last.

It is perhaps scarcely necessary to define what is meant by "glare." Every one is familiar with the uncomfortable sensation experienced when a bright light shines directly into the eyes; and we may accept this example as sufficient indication of the meaning of the term. It is only when we begin to analyze the conditions physical and physiological which give rise to the discomfort that we fully realize the complexity of the task we have undertaken. Before discussing the conditions causing glare in employing artificial methods of illumination, the author reminded his hearers of familiar examples under natural circumstances.

Proceeding, he said: Under artificial conditions, glare is experienced in an acute form when a bright light is almost in the line of vision between the eye and the object observed. Since glare is essentially an uncomfortable sensation, it is clear that the fundamental point in the problem before us is physiological. The eye shows a marvellous adaptability to extremes of intensity of illumination. Under favourable conditions, small print may be read easily by the feeble light of a farthing dip or in the brilliant blaze of a southern sun. Experiment has shown that the sensitiveness of the retina to impressions is enormously increased by protecting the eye from all light. If the eyes are lightly bandaged so that no pressure is exerted, but light is effectually excluded, in the course of about half-an-hour the retina reaches its maximum sensibility. It is then possible to perceive a glimmer of light which is quite invisible under any other conditions. Exposure to light, on the other hand, causes diminution of retinal sensibility, so that a much greater degree of change of intensity of illumination is necessary to produce a conscious impression than in the former circumstances. This constant variation in the sensitiveness of the retina, which obviously subserves so useful a purpose in every-day life, is called retinal adaptation. We have seen that in dark adaptation, when the retina is extremely sensitive, bright light causes an uncomfortable or even painful sensation—in other words, glare. We must conclude, therefore, that the condition of adaptation of the retina is one of the most important factors, if not *the most* important in the production of glare. It is not, however, the only cause, for glare may be induced by less rapid and less extreme variations in illumination than those adduced as examples.

It will have been noticed that, in most of the examples of the occurrence of glare in natural circumstances, it is caused by strong light reflected upwards into the eyes from the surface of the sea or ground. It would appear, therefore, that light entering the eye in such a direction is particularly prone to initiate the symptoms. In most circumstances only relatively feeble diffuse light enters the eye; for the sun or other source of light is high above the observer, and the eye is protected from the direct rays by the overhanging brow and lids, to which is often added some form of artificial head-gear. Light strongly reflected from below is for the most part worse than useless for visual purposes.

It might be argued that glare is often caused by *excess* of contrast, as in the familiar examples of the intensely bright beams of light from a lighthouse or the acetylene lamp of a motor at night. Analysis of the conditions will, however, show, I think, that the same causes are at work here, augmented by an unusual degree of dark adaptation of the retina.

Owing to the inherent defects of the optical apparatus of the eye, no retinal image is absolutely sharp. There is, therefore, a natural tendency to diffuseness of the image, no matter how perfect the eye, and spatial induction is apparently devised specially to counteract this irradiation, as it is called. Anything, therefore, which interferes with spatial induction must seriously interfere with clear vision.

The eye possesses an automatic protective mechanism against the influence of bright light in the iris. This acts as a diaphragm, which contracts concentrically—thus diminishing the size of the pupillary aperture, when the incident light is increased. By diminishing the aperture, it also reduces spherical aberration and tends to eliminate irradiation. The range of the apparatus is not sufficiently great to abolish the evil results of intensely high illumination. Hence the very *intensity* of the incident light may cause glare and even worse consequences by producing grosser changes in the retina than those which we have been considering. We may conjecture that profound chemical changes occur in the visual purple and even in the structural elements, leading to their destruction and loss of function. If the conjecture has any basis, we are naturally led on to inquire whether it is the mere *intensity* of the light which is the *causa causans*, or whether it is some particular form of energy in the incident rays which brings about the disastrous result.

Since the ultra-violet rays are known to be specially potent in effecting chemical change, attention would naturally be directed first to them. The eye, however, has a very efficient protective mechanism against them—at any rate, so far as the retina is concerned; for they are absorbed for the most part by the crystalline lens. As you are aware, much attention is being directed to these rays at the present time; and since it is not probable that they are more than a subsidiary element at most in the causation of glare, it may be well to neglect them in this connection. More to the point is the question whether colour or luminosity are prepotent in causing glare. Instances culled from Nature and artifice alike point to the fact that colour is if anything beneficial in reducing the tendency to glare. The natural adaptation of the retina to red has, however, to be taken into account. In mathematical phraseology, I am inclined to think that, so far as the physical side is concerned, glare is a fraction of luminosity rather than of colour. On the physiological side, I opine that temporal induction (retinal adaptation) and spatial induction are the pre-potent factors; the latter specifically invalidated by the direction of incidence of a superfluity of extraneous rays.

In the milder form of glare, the discomfort experienced scarcely amounts to pain. It is difficult or impossible to define where one ends and the other commences. Prolonged discomfort—not in itself painful—will undoubtedly induce pain. Here the psychological factor becomes important. The discomfort of even moderate glare causes screwing up of the eyes and puckering of the brows; and this prolonged muscular contraction is in itself painful. In the more acute forms of glare, however, pain is experienced at the outset. We have no evidence to show that any stimulus, however powerful, can produce pain through the purely visual nerve tracts. Pain is regarded as invariably due to the stimulation of certain different nerves—the nerves of common sensation. The question arises, therefore, whether the pain of glare is not due to stimulation of other nerves than the retina and visual paths. Is it possible that the pain of intense glare is due to over-stimulation of the nerve-endings? We may leave these rather esoteric conjectures and confine our attention to the more probable explanation already adduced, which at any rate accounts for the visual manifestations of glare and emphasizes most clearly the conditions to be avoided.

Discussion.

The discussion did not go far in matters of interest to the practical illuminating engineer; it being confined on this occasion to the physiological and pathological aspects of the question. In his introductory remarks, the President (Professor Silvanus P. Thompson, D.Sc., F.R.S.) announced that the engineers would have ample opportunity of discussing at a future meeting questions concerning the excitation of the eye by lights of different kinds; but on this occasion, it would be his business to rule out of order any discussion which went beyond the physiological aspect of the matter. What was wanted was that the subject should be discussed on a thoroughly scientific basis, and for elementary principles to be laid down for guidance. It was desired that a good lead should be given on known and well-ascertained physiological facts. The line struck out by Dr. Parsons in his communication would be very helpful; and the facts had been shown in a way they were not likely to forget.

Then Mr. Dow read a *précis* he had prepared of a number of communications received from foreign members. We asked for a copy of this for publication. It has not been granted, which appears to illustrate one of the drawbacks, in the matter of publicity, of a Society of the kind having an "official organ" conducted by the promoters. Summing up the points of the correspondents' communications, Mr. Dow said it would seem that it was generally recognized that brilliancy was the main point, and that colour might be responsible for considerable effects on eye accommodation. But by glare, people seemed to understand either extreme brilliancy of the source itself, or some contrast effect which was undesirably sharp.

Following, Dr. Green pointed out that this was a subject that bristled with difficulties of exact definition, and in openings for future work. One point which struck him with regard to glare was this, that what was glare to one person was not glare to another. He had found in different cases that the eye was very sensitive to certain lights. To him the mercury light was most irritating; while he knew of men who worked day after day under the mercury light without similar trouble. In their cases, however, he had found a considerable shortening of the violet end of the spectrum; while in his (Dr. Green's) own case, the violet end of the spectrum was longer than that of most people. He also found that among those who worked in photometry at the National Physical Laboratory, no one could see so far as he could into the ultra-violet region. It appeared to be a bright light to him when

it did not seem to be so to any other person. The same with the red end of the spectrum. When the red was seen, it appeared to be the most irritating of all colours. In his opinion, the questions of both luminosity and intensity would have to be taken seriously into consideration But there was the great difficulty that what might be glare to one person, another would find quite comfortable. There was also the question of the rapidity or otherwise of light adaptation of the eye. One person's eyes became easily and quickly adapted to bright light; while another person's might be very slow. And a light that might seem comparatively bright to one person might be very poor indeed when measured photometrically.

Snow blindness formed a text for Dr. Ganz. Dr. Kerr, the Medical Officer of the London County Council, commented on the largeness of the subject, and of the necessity of separating it up into several parts. There was the glare of incandescent light—gas or electric; the glare being due to the intensity of the illuminating surface, which might be quite small. Then there was the glare which occurred from windows, and particularly from those in which prismatic glass was used. There were also the varying effects at different parts of the day. Dr. Ettles defined glare as light in excess of the ordinary needs of the situation. Dr. Legge, of the Factory Department of the Home Office, referred to the subject of glassworkers' cataract; and then, alluding to the ninth question of a series that had been suggested for the purpose of discussion—viz., What is the best intrinsic brilliancy for illuminated signs and advertisements?—said he should be sorry if the Society adopted any compromise towards such disfigurements of the streets.

The speakers delivered themselves at considerable length; but at the close, the President said he was afraid they had not got far with the definition of glare. He also referred to the different effects of the same light at different parts of the day. Certain glow lamps in his house, if looked at by him in the evening, gave a very unpleasant glare; but looking at the same lamps in the daytime, they did not have the same effect. They gave him glare under one set of circumstances, but not under another. It did not seem satisfactory that they should not arrive at a consensus of opinion as to the definition of the simple word "glare."

The discussion was then adjourned to Feb. 15.

Presentation to Mr. G. F. L. Foulger.

Those of our readers who are acquainted with Mr. G. F. L. Foulger, formerly the Chief Distributing Engineer of the Gaslight and Coke Company, will doubtless be interested to learn that he made a welcome reappearance at the offices in Horseferry Road last Thursday evening, for the first time since the sad misfortune which befel him in October, 1908. The occasion was a presentation, on his retirement, from the chief officials of the Company with whom he had been associated in the course of his long period of service—44 years. The gift, a silver rose-water salver, was a beautiful specimen of silversmiths' work in *repoussé*, designed and executed by Mr. Nelson Dawson, the well-known artist, and bore the following inscription:—

> Presented to G. F. L. Foulger, Esq., with the Good Wishes of his Colleagues, the Heads of Departments, on the Occasion of his Retirement from the Service of the Gaslight and Coke Company.

The presentation was made by Mr. D. Milne Watson, the General Manager, supported by Mr. T. Goulden, the Chief Engineer, in the presence of all the subscribers. We are pleased to learn—and we are sure a large number of our readers will share the pleasure—that, despite the ordeal which led to his retirement, Mr. Foulger is apparently in the best of health and spirits.

Modern Coking Practice.—We have received from Messrs. Crosby Lockwood and Son a work bearing the above title, by Messrs. T. H. Byrom and J. E. Christopher. It embodies, with some amplifications, a series of lectures given by the latter gentleman, at the Wigan Technical College, to men engaged on coke-ovens; but the authors trust it may be appreciated by students generally, as well as by many who are engaged in the manufacture of coke, or who contemplate laying down bye-products plant. The matter is arranged in seventeen chapters; and it is amply illustrated. Pending a fuller notice of the work to be given in a future issue, we may say that the aim of the authors in its compilation has been, as they state in the preface, to produce a book "of use and benefit to those who are associated with, or interested in, the modern developments of the industry."

Decrease in the Number of Private Bills.—A correspondent of "The Times" has called attention to the fall in the number of Private Bills introduced into Parliament; and gives figures for the ten years 1901-10. In the first-named year, there were 243; in 1906, 208; last year, 139; now 112. The Bills of 1906 were deposited before the General Election. After the first session of the present Government, the number fell from 208 to 152—a drop of 56. The fall has continued until now, when the number is less by 96 than it was in 1906. The correspondent of our contemporary thinks the figures of 1910 must be largely attributed to the general feeling of insecurity caused in financial quarters by the Budget and the policy of the Government. It used to be reckoned that the amount of capital and loans for works sought to be sanctioned by Parliament in a single session was about 50 to 60 millions. The capital asked for this year does not amount to 12 millions.

STEAM IN GAS-PRODUCERS.

A paper by Herr J. Voigt from the "Allgemeinen Ingenieur-Zeitung" is reproduced in three recent numbers of the "Zeitschrift des Vereines der Gas-und Wasserfachmänner in Oesterreich-Ungarn" in which the author deals with the question of the influence of steam and of the loss of heat in the gas-making zone on the gasification of solid fuels in gas-producers. The article treats to a great extent the theoretical questions involved in the production of producer gas and water gas which are already treated in modern text-books on gas manufacture. It is therefore unnecessary to give the detailed formulæ and calculations of the author; but his general argument and his conclusions are indicated in the following epitome of the contents of his communication.

After referring to recent work by Herr J. Körting and Dr. F. Fischer and of other German authorities on gas-producers, which the author says does not touch the question of the dependence of the efficiency of the gas-making process on the admission of steam and loss of heat in the gas-making zone, he goes on to quote a report of investigations made by Dr. Wendt which support his own work and conclusions. The questions which he sets himself to answer by means of calculations based on the results of carefully conducted trials are as follows:

1.—How is the composition of the gaseous mixture altered when steam is introduced into the gas-making zone in increasing quantity up to a limit to be defined later? How are the calorific power of the resultant gaseous mixture and the temperature obtained by its combustion affected, and in what manner is the efficiency of the gas-making changed? Finally, how is the quantity of air necessary for gas-making altered, and what is the yield of gas in each case from the gasification of a given weight of solid carbon?

2.—How is the admission of steam to be conducted in order to secure the highest possible degree of efficiency of gasification and the highest possible temperature of combustion of the cold gas?

3.—What effect have the radiation and conduction of heat from the gas-making zone on the efficiency of gasification, and to what extent must the admission of steam be altered in order to secure the highest possible degree of efficiency of gasification and the highest temperature of combustion of the cold gas when there is a given loss of heat from the gas-making zone?

The author next proceeds to calculate the volume of gas relatively to the weight of carbon and of steam on the basis of the following data—viz., that the molecular volume of all gases at 0° C. and 760 m.m. pressure is 22·4; that the calorific power of 1 lb. of carbon is 14,580 B.Th.U.; that the calorific power of 1 cubic foot of carbonic oxide at 60° Fahr., 30 inches, and saturated, is 318·6 B.Th.U.; that the calorific power of 1 cubic foot of hydrogen at 60° Fahr., 30 inches, and saturated, when the resultant steam is cooled to 0° C., is 269·5 B.Th.U., or, if the resultant steam is cooled only to 100° C., 265·7 B.Th.U. The values for the mean specific heat of the gases at the temperatures in question are taken according to Dr. Langen's formulæ. Of the total carbon in the fuel charged into the producer, only the solid carbon resulting from the coking of the fuel is taken into account in all the calculations. The specific heat of the solid carbon for different temperatures is taken according to a formulæ of Kunze, which is as follows:—

$$C\,{}_0^t = 0{\cdot}2143 + 0{\cdot}1436\,\frac{1}{10^4}\,t - 0{\cdot}1975\,\frac{1}{10^8}\,t^2$$

Dr. Wendt in his investigations used a producer provided with horizontal passages for the removal of the gas at regular distances from the point at which air was admitted; and through these passages he observed the temperature and analyzed the gas corresponding to different heights above the base of the bed of fuel. It appears from his researches that the reduction of carbonic acid and the decomposition of steam by carbon do not proceed to any considerable extent below the temperature of 925° C., and that the lower limit for the gas-making zone in the producer is reached with that temperature of the bed of fuel. The gas must therefore leave the gas-making zone at 925° C., and its sensible heat, corresponding to the range of temperature from 0° to 925°, is lost, and must be deducted from the heat available from the carbon for gas-making. This heat, when 1 lb. of carbon is consumed with the theoretically necessary quantity of air for the production of a mixture of carbonic oxide and nitrogen (ideal producer gas), amounts, according to the author, to 4329 B.Th.U.; while the heat represented by the sensible heat of the resulting gases at 925° C. is 2826 B.Th.U. Hence there remains available for utilization in the gas-making zone 4329 − 2826 = 1503 B.Th.U.

The dissociation of the steam likewise takes place at 925° C., and the resultant gases escape from the gas-making zone at this temperature. The quantity of heat withdrawn by them from the gas-making zone consequently comprises both the heat of decomposition and the sensible heat of the gases. If the steam is decomposed so that the resultant gas is a mixture of equal volumes of hydrogen and carbonic oxide (ideal water gas), then the heat required for decomposition amounts to 65,543 B.Th.U. per 1000

cubic feet of this gas. The sensible heat corresponding to the range of temperature from 0° to 925° C. for this volume of these gases amounts to 30,551 B.Th.U. Hence the total consumption of heat in the production of 1000 cubic feet of ideal water gas at 30 inches, 60° Fahr., and saturated, amounts to 65,543 + 30,551 = 96,094 B.Th.U.

The mean specific heat of the gases constituting either ideal producer gas or ideal water gas for the range of temperature 0° to 925° C. is taken at 0·316. But when the steam is decomposed so that the resultant gas is a mixture of two volumes of hydrogen and one volume of carbonic acid and the mean specific heat of the carbonic acid for the range of temperature 0° to 925° C. is taken at 0·442, the total heat required for the production of 1000 cubic feet of the mixture at 30 inches, 60° Fahr., and saturated, amounts to 60,578 B.Th.U., of which 26,042 B.Th.U. is the heat of decomposition and 34,536 B.Th.U. the sensible heat of the gases leaving the gas-making zone at 925° C. Adopting the figures thus found—viz., that 1 lb. of carbon in the production of ideal producer gas renders available for utilization in the decomposition of steam 1503 B.Th.U., and that 1000 cubic feet of the gas resulting from the decomposition of steam by carbon utilize 96,094 B.Th.U. or 60,578 B.Th.U. according as the resultant gas is a mixture of carbonic oxide and hydrogen (ideal water gas) or a mixture of carbonic acid and hydrogen—the author tabulates the values corresponding to the gasification of 1 lb. of carbon when the proportion of steam used varies from *nil* to 0·612 lb.

TABLE I.

No.	Steam per Pound of Carbon.	Composition of the Gas in Volumes Per Cent.				Calorific Power of the Gas per Cubic Foot, at 60° Fahr. and 30 in. Bar. and Saturated.	Temperature of Combustion.	Steam per 1000 Cubic Feet of Air, at 60° Fahr. and 30 in. Bar. and Saturated.	Efficiency of Gasification Per Cent.		Air Consumed per Pound of Carbon, at 60° Fahr. and 30 in. Bar. and Saturated.	Yield of Gas per Pound of Carbon, at 60° Fahr. and 30 in. Bar. and Saturated.
		Carbonic Acid.	Carbonic Oxide.	Hydrogen.	Nitrogen.				E_1	E_2		
	Lbs.					B.Th.U.	Deg. C.	Lbs.			Cubic Feet.	Cubic Feet.
I.	..	..	34·7	..	65·3	110·5	1472	..	70·2	70·2	76·7	92·7
II.	0·100	..	35·5	2·4	62·1	119·6	1515	1·41	74·6	73·6	71·5	90·8
III.	0·200	..	36·3	4·8	58·9	128·6	1550	3·06	78·3	76·1	66 3	88·9
IV.	0·294	..	37·0	7·2	55·8	137·2	1584	4·83	82 0	78·9	61·5	87·0
V.	0·400	2·5	33·6	9·6	54·3	132·9	1551	6·60	81·3	77·2	61·3	89·1
VI.	0·508	4·9	30·4	11·9	52 8	128·8	1522	8·42	80·8	75·6	61·2	91·3
VII.	0·612	7·0	27·4	14·1	51·5	125·2	1495	16·08	80·5	74·5	61·0	93·6

In this table, the efficiency E_1 is calculated on the assumption that the steam required for decomposition is produced by the sensible heat of the escaping gas, whereas the efficiency E_2 is based on the steam being produced in a separate boiler plant with its own furnace. The temperatures of combustion given in the table are calculated on the assumption that $1\frac{1}{2}$ times the theoretically requisite quantity of air for the combustion of the gas is used. The calorific powers given are for the combustion of the hydrogen to steam at 0° C. The first set of figures in the table refers to the gasification of carbon without the use of steam; with the formation of carbonic oxide to the exclusion of carbonic acid. The fourth set of figures assumes that the whole of the heat liberated by such gasification is applied to the decomposition of steam for the formation of equal volumes of hydrogen and carbonic oxide to the exclusion of carbonic acid. For the second set of figures, it is assumed that 0·1 lb. of steam is employed to 1 lb. of carbon, and is decomposed wholly to equal volumes of hydrogen and carbonic oxide. In the third set of figures, the steam is taken at 0·2 lb. per pound of carbon for the same reaction.

If the steam is increased above the proportion used in the fourth set of figures, its decomposition must take place partly with formation of carbonic acid; and the fifth set of figures is calculated on the assumption that two-thirds of the available heat is applied in decomposing steam to form only hydrogen and carbonic oxide, and the remaining third of the available heat to the decomposition of steam to form only hydrogen and carbonic acid. The sixth set of figures is based on a reversal of these proportions—*i.e.*, only one-third of the available heat is applied to the decomposition of steam to form hydrogen and carbonic oxide, and the remainder to form hydrogen and carbonic acid. Finally, in the seventh set of figures, it is assumed that the steam is decomposed wholly to form hydrogen and carbonic acid. It will be seen that the highest efficiency of gasification and the highest temperature of combustion of the resultant gas coincide with the highest proportion of carbonic oxide in the gas. This highest proportion results when steam is introduced to such an extent that the whole of the heat liberated in the formation of ideal producer gas is utilized in producing from the steam ideal water gas—*i.e.*, when the conditions are those shown in the fourth set of figures in the table.

In the seventh set of figures, the highest proportion of steam which can be completely decomposed with the formation of hydrogen and carbonic acid by the utilization of the whole of the available heat from the ideal producer gas reaction, is taken. Any further increase in the amount of steam decomposed must draw upon the heat of reduction of the carbonic acid which is produced in the preliminary stage of the formation of the carbonic oxide of ideal producer gas—that is to say, the reduction of the carbonic acid will be restricted and the degree of efficiency of gasification correspondingly affected. For instance, if instead of regarding 1 lb. of carbon as being wholly consumed to form ideal producer gas, we regard a portion of the carbon as forming carbonic acid with the oxygen of the air, and the additional heat thus rendered available as being utilized for the decomposition of steam by the remaining portion of the carbon with the formation of carbonic acid and hydrogen only, the resultant gas will, according to the author's calculations, have the following percentage composition: 27·12 per cent. of hydrogen, 26·22 per cent. of carbonic acid, 46·66 per cent. of nitrogen. But if the reduction of the carbonic acid to carbonic oxide is prevented by decomposition of steam in this manner, there is a loss in the gas produced of the energy represented in the carbon gasified amounting to 1872 B.Th.U. per pound of carbon employed. If the amount of steam introduced is not sufficient entirely to suppress the reduction of carbonic acid, the loss will, of course, be correspondingly diminished; but it follows that if there is even the smallest interference with the complete reduction of the carbonic acid, resulting as an intermediate product in the first stage of the gasification of carbon by air, there must be a loss of energy. Consequently, any steam admitted in excess of the proportion indicated in Set VII. of the conditions shown in Table I. will result in a falling off in the efficiency of gasification below the values shown in the table.

Hitherto the complete decomposition of the steam introduced has been tacitly assumed; but, as a fact, the decomposition is only complete in comparatively few instances. Theoretically, if the whole of the heat derived from the gasification of carbon by air with the formation of carbonic acid were applied for the complete decomposition of steam in excess, the resultant gas should consist of only carbonic acid, hydrogen, and nitrogen, with an admixture of undecomposed steam. But in reality considerable quantities of undecomposed steam occur in gaseous mixtures which contain a considerable amount of carbonic oxide. Mond gas may be quoted in illustration of this fact. In the Mond process, large quantities of steam are introduced into the producer in order to lower the temperature of the bed of fuel and thus cause a high yield of ammonia. In a Mond gas plant, about 3·7 lbs. of steam are blown into the producer for every pound of carbon gasified, or 1 lb. of steam for every 16 cubic feet of air. About 73 per cent. of the steam leaves the producer undecomposed. The analysis of the resultant Mond gas is shown below alongside the analysis quoted by Dr. F. Fischer of a gas which was made in a producer of a different type, consuming anthracite instead of bituminous coal, but worked with a considerable excess of steam:—

	Mond Gas.		Anthracite Gas (Fischer).
Carbonic acid . . . per cent.	16	..	15
Carbonic oxide	11	..	9
Hydrogen	29	..	21
Methane	2	..	1
Nitrogen	42	..	54

The author proceeds to state that systematic investigations on the effect of undecomposed steam with varying steam supplies on the loss of heat from the gas-making zone, have not been carried out. A knowledge of the amount of this loss is requisite for calculating exactly the effect of an ample supply of steam on gas making. Even assuming that the steam which passes through the producer undecomposed leaves it at the full temperature of the gas-making zone (which is improbable), the author calculates that the loss of heat consequent on the undecomposed steam can have only a small effect on the efficiency E_1, but will reduce to a somewhat greater extent the efficiency E_2, owing to the expenditure of heat in the production of the undecomposed steam. It has already been shown that the admission of more steam than that indicated in Set VII. of the conditions indicated in Table I. reduces the efficiency below the values shown for that set. The decrease of efficiency is still further enhanced by increasing the incomplete decomposition of the steam. Having regard to these facts and the data given in Table I., the following conclusions may be drawn as to the utilization of the heat of the fuel in gas-producers: (1) For the attainment of the highest efficiency of gas making and the highest temperature of combustion of the resultant gas, the whole of the heat liberated by the complete gasification of the carbon by means of air with the formation of carbonic oxide and nitrogen must be utilized for the decomposition of steam by carbon, with the formation of hydrogen and carbonic oxide; (2) for the attainment of the maximum utilization of the fuel gasified, the amount of steam admitted to the producer must be so fixed that the proportion of carbonic oxide in the gas is a maximum.

The loss by radiation from the gas-making zone has hitherto been assumed to be neutralized by the sensible heat of the previously heated carbon. As a fact, this is rarely the case; and

TABLE II.

Series.	Specific Loss of Heat from the Gas-Making Zone.	Loss of Heat from the Gas-Making Zone. Percentage of the Heat of the Carbon Gasified.	Heat Liberated by the Gasification of 1 lb. of Carbon to Ideal Producer Gas.	Heat Expended in Making 1 Cubic Foot of Hydrogen Simultaneously with	
				Carbonic Oxide.	Carbonic Acid.
	B.Th.U.		B.Th.U.	B.Th.U.	B.Th.U.
A	..	..	2079	174	82
B	270	1·9	1809	183	86
C	576	4·0	1503	192	91
D	1080	7·4	999	208	99
E	1620	11·1	459	214	107
F	2079	14·3	..	239	114

hence it is desirable to investigate the effect of the loss of heat from the gas-making zone on the gasification of the fuel. Taking the sensible heat of 1 lb. of carbon, which has been raised to the gas-making temperature of 925° C., as equal to 576 B.Th.U., the author inserts different values for the loss of heat by radiation and conduction from the gas-making zone per pound of fuel gasified in the equation showing the thermal effect of the gasification of carbon by means of air with the production of only carbonic oxide and nitrogen. The results of his calculations are shown in Table II.

In series C of the above table, the specific loss of heat is taken as equal to the sensible heat of 1 lb. of carbon at 925° C., and, consequently, the values in the last three columns of this line of the table correspond with the figures adopted for the calculation of Table I. For any other series of Table II. a corresponding set of values for Table I. could be calculated from the figures in the last three columns of Table II. For the construction of gas-producers, it is specially important to ascertain the quantity of steam which should be admitted in order to secure the maximum utilization of the heat of the fuel without increasing the loss of heat from the gas-making zone. It has been already shown that the maximum utilization of the heat of the fuel is secured when the heat resulting from the gasification of the carbon to form, with the oxygen of the air, carbonic oxide is applied to produce hydrogen and carbonic oxide by the decomposition of steam with carbon. The highest attainable efficiency is calculated on this basis for each series of Table II.; and Table I. is also based on this amount of steam being admitted. By plotting out corresponding curves on a diagram, it will be found that the result of increasing the supply of steam above the values shown will result in carbonic acid being produced in the gas and in the efficiency of the working and the temperature of combustion of the gas produced being diminished.

The specific value of the gas-making zone depends partly on the construction of that zone of the producer. It is also partly affected by the specific gas-making power of the producer—*i.e.*, by the weight of solid carbon gasified per hour per square foot of the average internal cross sectional area of the gas-making zone. The specific loss of heat is in inverse proportion to the specific gas-making power. While the amount of gas made varies with the load on the producer, the heat radiated and conducted *cæteris paribus* is the same, and is distributed over the fluctuating quantities of carbon gasified. Thus, for the same producer, the supply of steam per pound of carbon remaining the same, a rise in the specific gas-making power is accompanied by a decrease in the specific loss of heat from the gas-making zone, and *vice versâ*. According to determinations by the author, the specific gas-making power varies with ordinary producers between 4·8 and 16·4 lbs. of carbon per square foot of cross sectional area at the gas-making zone. A certain proportion of the heat is, however, lost so far as gas-making is concerned in the water-pan beneath the grate. Producers which are water-jacketed round the gas-making zone undoubtedly lose more heat through the vigorous conduction. There is also more loss with most inclined or other special grates, which generally are placed outside the part of the walls of the producer protected by non-conducting material.

The most favourable proportion of steam for introduction in any producer must be determined experimentally for the particular apparatus, as the types of construction vary considerably. For instance, a trial may be made first with about 4½ lbs. of steam per 1000 cubic feet of air, and the steam then gradually reduced until the proportion of carbonic oxide in the gas reaches a maximum, which condition connotes the maximum utilization of the fuel gasified. The calculations so far have presupposed that the steam used is dry, which is a condition often unfulfilled in practice. Water contained in the steam must be vaporized in the gas-making zone, and will therefore withdraw from the latter a certain amount of heat. The heat required for decomposing wet steam is greater than that required for decomposing the same weight of dry steam; and the practical effect of the use of wet steam is that the quantity of steam decomposed, or of hydrogen formed, is reduced, and the efficiency of gas-making falls below the values stated in the tables.

Every natural fuel contains a certain amount of moisture—generally speaking, in inverse ratio to the geological age of the fuel. Thus anthracite contains the least, and lignite the most, water. The moisture of the fuel is vaporized during the preliminary warming of the fuel by the sensible heat of the gas from the gas-making zone. But as the proportion of moisture rises, the carbon in the fuel diminishes, and with it falls off the heat available for the evaporation of water. It may happen that the sensible heat of the gas which leaves the gas-making zone at 925° C. may not suffice for the complete evaporation of the water contained in the fuel. The author calculates that when the percentage of moisture in a fuel amounts to 30 per cent., it must contain at least 31 per cent. of solid carbon, in order that the moisture of the fuel may be completely evaporated in the gas-making zone and that the maximum utilization of the heat may be attained by the admission and decomposition of the necessary quantity of steam.

The amount of moisture in anthracite, coal, and the coke and briquettes made from them, as well as in coke made from lignite, is always below 30 per cent., and the amount of carbon is always above 31 per cent. Brown coal or lignite briquettes also contain 30 to 35 per cent. of solid carbon, and rarely as much as 30 per cent. of moisture; so that they may be gasified in producers with a maximum utilization of the heat. On the other hand, the moisture in lignite itself (and in peat) often exceeds 30 per cent. of its weight; while the proportion of solid carbon is often less than 31 per cent. With such fuels the amount of steam admitted must be reduced, and, if the moisture exceeds (say) 45 per cent., suppressed altogether. As the heat liberated by the gasification of carbon by the oxygen of the air which is not consumed in decompostng steam raises the temperature of the gas produced above 925° C., the corresponding increase of sensible heat in the gas serves to evaporate the water in the fuel which otherwise would not be evaporated. Therefore, the utilization of the heat of the solid fuel in the producer is reduced below the figures shown for the attainable efficiency and temperatures of combustion in the tables.

The introduction of steam into the producer increases the durability of the lining in the gas-making zone, and in many cases facilitates the choice of apparatus. The foregoing observations on the effect of steam on the utilization of fuel and working considerations lead to the conclusion that a large admission of steam is advantageous in producers. For example, Herr J. Körting has suggested that 1 lb. of steam to 1 lb. of carbon is a proper proportion. Dr. F. Fischer holds a similar view, and states that 17½ lbs. of steam per 1000 cubic feet of air supplied is most advantageous. On the other hand, the present investigation indicates that for the most favourable utilization of the heat of the fuel in the producer about 0·3 lb. of steam only should be introduced per pound of solid carbon, or about 5 lbs. of steam per 1000 cubic feet of air, provided the losses of heat from the gas-making zone are kept low by proper construction of the substructure of the generator and proper jacketing of the generator itself. The heat liberated by the gasification of the carbon by the oxygen of the air to carbonic oxide is completely consumed in the decomposition of this small quantity of steam. It follows, therefore, that there is a reduction of the temperature of the gas-making zone as compared with the gasification of carbon without admission of steam—an important consideration in regard to the durability of the lining, and in most cases to the ease with which the clinker may be removed. The second important result of this investigation is that it establishes the remarkable effect that high losses by radiation from the gas-making zone exert on the amount of steam most suitable, and on the efficiency which may be attained in the gas-making process referred to.

The Birmingham City Council have unanimously passed a resolution increasing the salary of Mr. F. W. Macaulay, the Elan Supply Resident Engineer, from £800 to £1000 per annum, and the salary of Mr. William Gray, the Local Engineer, from £500 to £600 per annum; the increases to take effect as to one-half from the 1st inst., and as to the other half from Jan. 1 next. In bringing forward the proposition, Alderman Beale said Mr. Macaulay had a very wide field of operations to cover. He had carried through a great deal of constructive work which would have had to be done by Consulting Engineers if they had not had such a skilled Engineer in their own service. His duties had considerably increased since his appointment; and he had always carried them out most admirably. As demonstrating his enthusiasm in his work, Alderman Beale mentioned that Mr. Macaulay had only recently utilized his holidays to investigate methods of filtration in foreign countries, because he thought they were not getting the best results on the Birmingham system. As the outcome, they hoped to experiment on lines which would reduce the charges at their filtration works. Mr. Gray, the indefatigable official in charge of the distribution mains in Birmingham, had also discharged his duties in such a way as to entitle him to the increase in salary recommended by the Water Committee.

MANCHESTER JUNIOR GAS ASSOCIATION.

Members of the Association met on Saturday at the Victoria University—Mr. JAMES TAYLOR, the President, in the chair. Two papers were read.

The first was by Mr. A. L. HOLTON, and was as follows:—

NOTES ON THE MANUFACTURE OF SULPHATE OF AMMONIA.

The Technical Press of late has contained many descriptions of special sulphate of ammonia plants, and the working of same; and of special pieces of apparatus as an auxiliary to a sulphate plant. Therefore, rather than give a description of the plant now in my charge, I purpose considering the question of obtaining the best results out of the plant that it is our fortune, or misfortune, to be called upon to supervise, and to give some hints on the choice of new plant.

STILLS.

Intermittent stills are now almost a thing of the past; and my observations will apply mainly to the apparatus and working of the continuous type of still. The ammoniacal liquor should be delivered to the stills in a continous and constant feed, and, to ensure this, may be fed to the superheater either direct by liquor pump, fitted with a relief valve and connections from pump delivery to suction (the relief valve being set to a definite, and not too high, pressure), or from a high-level tank connected by a tap and pipe-line to a small intercepting tank fitted with a ball-cock, and fixed a few feet above the still-head. Either method will be found reliable; the choice depending upon the local conditions. Avoid, if possible, fixing liquor pipe-lines below ground; so that any leaks may be immediately detected and made good.

It is economically important that the liquor be raised to as near boiling point as possible prior to entering the distillation column; a thermometer being fixed on the inlet-pipe and noted from time to time. Since all sulphate plants have a source of heat for this purpose, in either the waste saturator gases or the waste liquor, it is only a matter of arranging a suitable superheater to be fed by either of these, or, on small plants, possibly a combination of both, to secure a high temperature to the ingoing liquor. The continuous stills are varied in their design; but the principle of either blowing steam through the ammoniacal liquor or causing the liquor to flow over the hot surface of plates or other material, is applied in nearly all cases. Possibly a still constructed on the principle of the Feld washer, in which rising steam and ammonia gases are made to pass through a spray of liquor in each successive tray, may come in due course.

The fixed or liming portions of a still get coated with calcium salts, tarry matters, &c., that call for easy facilities for cleaning purposes—a point too often lost sight of in their design. I have had experience with six different makes of stills, and in nearly every case the need for having to clean them out seems to have been either lost sight of or adequate arrangements have not been provided. Fortunately, the newer forms of stills provide against this drawback. The small cleaning doors often arranged allow of only a partial cleaning out, and at times the still must perforce be taken to pieces to make a satisfactory job. Where such conditions exist, and the still is in one column, I would advise that the free and fixed portion of the still be placed on separate bases, with some suitable arrangement for taking the fixed portion easily to pieces.

The so-called free portion of the still rarely gets clogged, and needs but little cleaning; hence the advisability of making it a separate column, and thus avoiding the expense of having to take it to pieces every time the fixed portion requires attention. The usual serrated caps or hoods for the distribution of steam and ammonia gases in each successive tray must be securely held in position, and yet readily liberated for cleaning purposes. Once allow free movement, and the efficiency of the still is impaired to a serious extent, and may even stop its working. Let one hood be removed from its place, and the steam and gases will escape to the next tray without doing their intended work. Where holes take the place of serrations, the sum of their area in each tray should be greatly in excess of the main gas-way from each tray, to allow for the extra friction and variations in the supply of steam. The length of run between the times for cleaning may be extended by increasing the diameter of the holes in the bubbling hoods, especially in the fixed portion of the still.

The serrated hoods are to be preferred, for they adapt themselves better to all variations in volume; and in the fixed portion the hoods should be raised a few inches from the bottom of the tray, to allow for a little sediment to accumulate before it clogs the teeth of the bubbling hood—another point conducive to the length of a run. The liquor-overflows from tray to tray should be of large area, especially in the liming portion of the still. Ten times the area of the liquor feed-pipe will be found a convenient size; and in rebuilding a still, this is a point easily remedied if those already fitted are below this figure. Steam is usually admitted at two points—viz., at the bottom section of the still and in the section where the lime enters; and here open-ended pipes are to be preferred to closed pipes with small holes in same, immersed in the liquor, for during stoppages the lime sediment is drawn back into the pipes, with its attendant evils.

All stills should be provided with a relief pipe or valve and pressure-gauge. A very simple and efficient one is that fitted by the Chemical Engineering Company to their plant. It consists of a small cast-iron box connected by a 2-inch pipe to the bottom of the still. On the top of this box is fixed a length of 2-inch wrought-iron tubing to three-quarters the height of the still. A second length of 2-inch wrought-iron tubing is also fixed, and runs up alongside the former pipe, but only half its height—it being extended the other half by a length of glass tubing. The height of the liquor in the glass varying with the pressure of the stills, the effect of any alteration in the flow of either liquor or steam is instantly noted.

In experimenting to ascertain the best working conditions of a still, this is indeed a valuable help. To regulate the outflow of the still, and to ensure that no steam shall escape, is a matter of first importance. Regulation by means of a cock with a head on the waste-liquor pipe is by no means satisfactory, and requires constant attention. The Company just mentioned provide their stills with a very efficient float-valve fitted with a sight-gauge, which can, of course, be attached to any type of still. At first we experienced difficulty in getting the joints of the floats to stand for any length of time; but now we have them welded by the oxygen-acetylene flame, with very satisfactory results.

It is quite a common thing to find stills fitted without any catch-box on the outlet gas-pipe; and often where a catch-box is fitted, the pipe leading away the condensed vapours is directly connected up to the still. If one considers for a moment the violent action that is going on in the stills, and the tendency the globules of liquor enveloping particles of gases have to be carried forward, the importance of fixing a catch-box on the outlet-pipe will be realized. Some makers rely on making the top segment of a still of much greater depth than the lower one. No doubt this serves a useful purpose; but when the still does boil or froth over, as there is always a liability of its doing, it is surely wiser to fix a trap to prevent the liquor entering the saturator.

The catch-box should be fitted with one or more baffle-plates, and the condensed liquors carried away by a 5-feet seal-pipe (emptying into a funnel and pipe) to the liquor tank. It is necessary to have a tap on the seal-pipe just below the catch-box; for should a sudden rush of liquor come, through irregular working, the seal is broken through the large rush of gas following, and the tap must be closed for a minute or two to allow sufficient liquor to collect to fill the seal-pipe. In ordinary working, the amount of liquor from the baffle-box will be only a very thin stream; but directly the still is either holding up or frothing violently, the volume is greatly increased, and the steam and liquor reduced to remedy it. Where the condensed liquors are carried directly to the still, it is an impossibility to know of any variations in volume passing over until an increased volume in the saturator both tells its tale and leaves its trade mark—a batch of blue salt.

The extent to which various ammoniacal liquors froth varies considerably, even under similar conditions as to steam and the amount of liquor distilled, and will occasionally present difficulties in distillation. Four years ago, this was a source of continual worry to us; and after several experiments, I found that the tarry matters from the "devil's-water" well will, when added to the ingoing liquor in very small quantities and at long intervals, stop the frothing action immediately. We have therefore fixed a pipe to the bottom of the "devil's-water" well, and can pump into the still small quantities of these tarry matters should it be required.

LIMING OF STILLS.

The capacity of the plant use should determine the system of liming; regularity of feed being sought. The small amount of lime needed on the lesser makes per day precludes regular pumping, or even a syphon system; and the lime is admitted in such cases at frequent intervals. In these conditions, the tray or compartment where the liquor and lime first mix in the still should hold sufficient lime solution to meet the needs of the liquor during these intervals. For medium-sized plants, the lime solution may be fed by gravity, with a floating syphon from a high-level tank; while for larger makes, regular pumping is usually adopted. The Chemical Engineering Company make a special automatic liming apparatus, two of which we have used for seven years.

The common practice is to make the lime solution with water; but I strongly urge the use of the waste liquor for this purpose. It has the advantage of reducing the amount of mother liquor. Less steam is used in the mixing-tank; and, should the stills be working short of either lime or steam, the ammonia set free in the lime-pan gives immediate warning. Where regular tests are not taken of the waste liquor for NH_3, this will prove a valuable tell-tale; and in such cases, the mixing-pan should be so placed that the ammonia vapours given off when the plant is not receiving proper attention become a nuisance to the workmen.

SATURATORS.

Three kinds of saturators—the hand-fishing or piano type, the bottom discharge, and the closed saturator fitted with a Wilton type of ejector—are, no doubt, familiar to all. For small makes, the piano type will be found the best, as it requires less additional plant; and the amount of time required to fish one or two tons of salt is so small that there is ample opportunity for the other duties of a plant requiring the attention of one man.

The bottom discharge saturator requires a high and low level mother-liquor tank, and either an injector or some other means of raising the mother liquor from one to the other. This is necessitated by the fact that a large quantity of mother liquor is discharged along with the salt at each opening of the valve. This

type of saturator is applicable to all makes of sulphate per day; but there are certainly more parts to get out of order than with the simple hand-fishing type. When such a make is reached per day that the attendant has not sufficient time to spare from his fishing operations to attend to the other part of the work, then is the time to take this type of saturator into consideration.

The closed saturator, with the Wilton ejector, has these advantages over the other—there is no valve to get out of order, and the mother liquor returns at once by gravity to the saturator from the discharge or settling box. The ejector is of simple construction, depending on the lightening of the column in the discharge pipes to eject the salt. We are now making our ejector pipes of 3-inch copper tubing, with phosphor-bronze flanges.

The position of the store will be one guiding factor in the choice of a bottom discharge or closed saturator with a Wilton ejector; for with the latter the salt is ready for removal to the store at a higher level than with the former, and, consequently, less labour is required in stacking. It is a great mistake to have saturators too big for their work; a good boil being an essential. Therefore, avoid this drawback in all new plants. A saturator having a working acid-bath capacity of 30 cubic feet will make 2 tons of salt per 24 hours in the hand-fishing type. The Wilton saturator at the Bradford Road works of the Manchester Corporation has a working acid-bath capacity of 125 cubic feet, and makes 24 tons of sulphate per day without any difficulty.

An examination should be made of the ammonia distribution or cracker pipe, to ascertain if the gases are being distributed throughout its entire length; and should there appear no sign of wear on the end holes of the pipe, it will be advisable to block up a few of them near the entrance of the gas delivery. Local alkalinity may take place if there is not a good boil on the saturator, and the still gases are mainly passing through the bath in one place. A short length of ¼-inch pipe should be screwed into the inlet and outlet gas-pipes to facilitate washing the gas-ways with water, and for opening when stopping the plant—using wood plugs to close them up.

Every saturator should be fitted with an efficient baffle-box. An enlarged lead pipe, fitted with a perforated lead hood through which the waste saturator gases are made to pass, will answer the purpose. This, too, will require an occasional washdown with hot water, to keep it from making-up. Many a leaky condenser is caused by the acid mist from the saturator being carried forward and acting on the iron pipes.

The preliminary drying of the salt is always done near the saturator; and the arrangement for so doing forms one of the saturator fittings. With the hand-fishing operation, the well-known lead-lined draining table, with a good fall towards, and connected to, the saturator, is hard to beat. Where centrifugal drying is not resorted to, both the bottom-discharge and closed types of saturators should have their salt collected in a lead-lined box; and I would strongly advise it to be so made and fixed that, when full of the salt and mother liquor, it can be tilted and the liquor poured off in this manner. Such a procedure is better, and gives a dryer salt in a given time than when allowing the liquor to drain off from the bottom of the box. Small tilting tubes running on a mono-rail form a convenient arrangement for removing the sulphate to the store heap; and if the saturator and collecting box be placed on a high level, the cost of labour in stacking the sulphate will be but a very small item. For large makes of sulphate—say, about 20 tons per day—drying by centrifugal force and mechanical conveyors will be found the cheapest.

Condensing Plant.

The waste saturator gases, after leaving the lead baffle-box, are connected by cast-iron pipes to one or more superheaters and condensers; and in this part of the plant especially, ready means of finding any leakage and repairing it should be the point to aim at. The gases are of a highly poisonous nature, containing about 30 per cent. of sulphuretted hydrogen; and it will be wise to fix all examination plugs in such a position that if a workman was overcome with the gas he would fall clear of the issuing stream of gas. Especially should this be the case in plants worked by one man; and when two or more men are employed, a stringent rule should be enforced "that all repairs and cleaning done on the waste gas-pipes and plants should be performed by one or more men with an attendant in readiness for any possible emergency."

There need be no occasion to fix any waste-gas pipe less than 3 feet above ground-level, except just where it enters the purifiers; and under no circumstance should this part of the plant be placed inside a building or in a confined space. The superheaters and condensers I prefer are of the battery type, fixed in a horizontal position with the end plates free from any fittings. A leaky condenser tube can then easily be stopped by any workman by simply taking off the two end-plates and driving in a wood plug, and a proper repair done when two or three tubes need replacing or at the general overhauling of the plant in the summer. Pressure-gauges should be fixed on the inlet to condensers.

The products of condensation from the waste gases, usually termed "devil's water," should be collected in a tank and returned again to the distillation still along with the gas liquor—thus disposing of a very obnoxious liquid and at the same time recovering any ammonia that may have passed the saturators during irregular working.

Treatment of Waste Gases.

The waste saturator gases must be purified of sulphuretted hydrogen prior to discharging into the atmosphere; and the most general scheme is by the usual oxide purification. An efficient and cheap arrangement is a heap of oxide placed on and around grids raised about 6 inches above a brick floor. Two such heaps should be provided, and the connections made by pipe-line and water-sealed valves. The practice of passing the waste gases to the gas-works purification plant is not to be recommended.

Where a little more skilled supervision is available, the waste saturator gases may be burned in a special furnace and the SO_2 formed neutralized by passing the gases, after cooling, through scrubbing towers packed with hard limestone. The gases may also be burned in a Claus kiln and the sulphur recovered.

Where a sulphuric acid plant is working, the best and most remunerative method of dealing with these gases is to burn them in a special furnace, and pass the SO_2 formed to the nitre ovens and then forward to the Glover tower. The choice of process depends largely on the size of plant and the skill of the labour employed. A common feature to all of them is the importance of cooling the gas thoroughly and having it in a dry condition; ammonia and tarry vapours being carefully eliminated.

Treatment of Waste Liquor.

The disposal of the waste liquor from the stills is getting a very serious problem, and will become more so as the treatment of sewage on bacteriological lines is adopted. The stringent requirements that are being enforced by rivers and sewage authorities make this question one of urgent importance. The waste liquor possesses the power to absorb a large amount of oxygen, due mainly to the amount of phenols and sulphocyanides it contains. Dr. F. W. Skirrow, in his paper before the Society of Chemical Industry, in December, 1907, gives an analysis of waste liquor and the relative oxygen absorption properties. Any process adopted cannot hope to secure much remuneration towards the cost of treatment in the way of recovered products. Mr. John Radcliffe, of East Burnett, has patented a process, the details of which have recently been published in the Technical Press; and it would be of interest to know the oxygen absorption properties of his treated effluent. Dr. Grossmann has also done considerable work on this question, and aims at using the treated waste liquor for steam-raising purposes.

For some years past, Dr. Fowler has been experimenting on the direct biological purification of ammonia recovery liquors on percolating filters. For this to be possible, dilution of the liquor is necessary; the amount of dilution depending on the strength of the liquor. Where diluting water is not easily procurable, the purified effluent may be used for diluting purposes. Under Dr. Fowler's directions, experiments have been carried out on these lines at the Bradford Road works over a period of about five years; and the results are such that plans are under consideration for a considerable extension of the filtration plant. Experimental filters have also been recently started at other works—one being for the purification of the waste liquor from coke-ovens. As it is Dr. Fowler's intention to deal with the subject at length before the Society of Chemical Industry, it is at present inopportune to go into further details.

Waste liquor is also used for the partial absorption of the SO_2 produced in the burning of the waste gases, as already described In such a process, previous settling of the lime sludge is not resorted to; the waste liquor being passed directly down brick wash-towers, up which ascend the gases from the sulphuretted hydrogen furnace. The waste liquors leaving the towers is of light green or blue colour, and contains a little lime in suspension, which is removed by the usual settlement. At some gas-works, part is used for quenching the hot coke as drawn from the retorts, and part is evaporated in the ash-pans.

General Working.

The steam pressure should be reduced to at least 20 lbs., though with smaller plants I should advocate it being much lower, to admit of finer steam adjustment. It has already been noted that there are two points on a still at which steam is to be admitted. The one at the bottom of the still must receive the main amount, and that at the first liming section only just sufficient to keep the lime from settling. Tests should be made at the second tray above the liming section, and should contain not more than 0·10 per cent. of free NH_3; H_2S and CO_2 being absent, or only present in very slight traces—the steam being adjusted to meet these requirements. Having adjusted the steam, the lime should be added in such amounts that the waste liquor contains 0·01 per cent. of NH_3. A better method for controlling the liming operations, however, is to test the waste liquor for total and free lime, and to work with 15 per cent. of free lime in the total found. Thus, a test recently made gave 0·540 per cent. total CaO and 0·102 per cent. free CaO; giving 18·88 per cent. of free lime in the total found.

Many sulphate makers will only use the best pan acid for feeding the saturator, and, of course, pay accordingly. Tower acid made from spent oxide is quite good enough for the purpose, with a small saving in cost. There are two ways of working a saturator. First, to fill it up with a charge of acid and mother liquor or water, and then allow it to gradually work down to the adopted salting strength—preferably 58° Twaddel, when acid is gradually added to keep it to this strength during the time fishing operations are in progress, and then fill up again as before. The other method is to keep the strength to as near the adopted salting strength as possible by running in the acid in a continual stream through a small gauge-box. For one-man plants, the former method is

undoubtedly best, and the second method where the man's whole time is taken up by saturator and still duties.

Blue sulphate is a constant source of anxiety to the sulphate maker, and is mainly due to the saturator liquors becoming totally or locally alkaline. This can be brought about in many ways, such as (*a*) the acid feed stopping; (*b*) syphoning-over of stills; (*c*) back-pressure on saturators through partial blockage in condenser system, or restricted areas in their first design—the seal of the cracker-pipe being thereby reduced; (*d*) the still gases escaping mainly at one portion of the cracker-pipe; (*e*) the building-up of the hard sulphate just in front of the cracker-pipe and stopping free circulation of the acid liquors. The precautions necessary to guard against these have already been dealt with.

The well-known intense blue colour does not appear until after the salt has been in the store for a few days, and oxidation taken place. Its presence, however, can readily be found by adding a little hydrogen peroxide to a small quantity of the freshly-made sulphate, when, if blue salt is being made, the well-known blue colour will be instantly formed.

Costs.

It is not my intention to go into any details relating to the costs of manufacture, for every works must of necessity vary. In the description of the Bradford Road works of the Manchester Corporation, prepared and presented by my Chief, Mr. J. G. Newbigging, on the occasion of your visit, the total cost of manufacturing a ton of sulphate of ammonia is given—*i.e.*, £2 10s. 11d. This figure includes capital charges, acid, lime, fuel, wages, salaries, repairs and maintenance, rates and taxes, gas, water, and sundries. The cost of the acid per ton of sulphate, which is included in the above amount, is £1 2s. 1d.; leaving £1 8s. 10d. for all the other charges. It would be totally irrelevant to compare these costs on a make of 4200 tons per annum (say) with a works making a tenth this amount.

The process is purely a chemical one; and if the various stages are regulated by the indications and directions given, the amount of waste will be reduced to a minimum. Every works of whatever size should keep a separate account of its sulphate plant, and check its efficiency on the gallons of 10 oz. liquor (by distillation test) used per ton of sulphate produced; a balance-sheet being made up of the NH_3 distilled and the NH_3 sold as sulphate. It is a gross mistake to calculate its efficiency on the pounds of sulphate per ton of coal carbonized. The acid should be all accounted for in the sulphate made, as the amount lost by the waste gases carrying a little forward as mist is practically speaking *nil*.

The design and general arrangement of the plant is the controlling feature in the labour charges. For packing sulphate, one man and a youth, with a simple home-made bagging machine, should pack, weigh, and sew, at the least, 10 tons per day; and it is advisable to so arrange the work that the man in charge performs these duties during stoppages of the plant.

For methods of analysis of gas liquor, let me refer you to the published report on alkali works by the Chief Inspector for the year 1903.

A short discussion followed, during which the President and other speakers paid Mr. Holton a high compliment on the essentially practical paper he had given them. Several questions were put to, and answered by, the writer of the paper. These dealt with the proportion of waste liquor to be returned to the liming pan, the quality of the oxide obtained from the salt-purifier compared with the oxide from the gas-purifier, the temperature at the inlet of the liquor, and steam pressure. One important point raised was that of cost. Mr. Holton admitted that wages formed a big item—but said this was generally due to the frequent handlings that took place—this applying more particularly to small plants. He was convinced, however, that, with system and care, the cost under this head could be considerably reduced. The waste-liquor problem, Mr. Holton agreed, was becoming a serious one, and therefore there was all the more reason why they should give it their close attention. He detailed what was being now done in Manchester to solve it.

On the motion of Mr. R. B. Braddock, seconded by Mr. Mercer, a vote of thanks was accorded Mr. Holton for his able paper, which, as the President put it, though technical, was easy to understand.

Course of University Lectures on Gas.

At this stage, and before the adjournment for tea, the President announced that Professor Dixon, of Manchester University, had kindly consented to deliver another address to the members of the Association. Further, the Senate had agreed to a course of lectures on "Gas" at the University; and he thought they had reason to congratulate themselves on this fact. (Hear, hear.) Mr. Taylor drew attention to the return debate on the subject of "Gas v. Electricity for the Production of Heat and Power" between the members of their Association and the Manchester Students' Section of the Institution of Electrical Engineers. The date was Tuesday, Feb. 15; the place of meeting being the Manchester Municipal School of Technology. At the last debate, it was considered that the gas engineers had the best of it; and he understood that the students were making special efforts to retrieve their lost laurels.

On resuming after tea, Mr. S. Carter read his paper on

SOME EXPERIENCES IN MANUFACTURING CARBURETTED WATER GAS AT THE GARSTON (LIVERPOOL) GAS-WORKS.

In introducing this subject, it would perhaps be as well if a brief outline were given of the special function of these works. They were one of the earliest installations in this country, and were erected by Mr. W. King, M.Inst.C.E., in 1894, as an auxiliary to the other five works to meet the increasing demands of the public. The plant consisted of four sets of Messrs. Humphreys and Glasgow's double superheater type (having a guaranteed capacity of 750,000 cubic feet per set per day), with the usual seals, scrubbers and water-tube condensers, atmospheric pipe condensers, relief gasholder, and eight water-lute purifiers, 40 ft. by 20 ft. by 5 ft. 6 in. During a period of about two years, pure carburetted water gas, of an illuminating power of 21 candles (tested in a flat-flame burner), was made and distributed from the works. But there were practical difficulties in the use of such a heavy gas (sp. gr. ·640) in the ordinary burners, stoves, &c.; and therefore it was decided to make 24 to 25 candle carburetted water gas (free from carbon dioxide), and mix it with 15 to 16 candle coal gas (oxide purified), drawn regularly, in carefully measured quantities, from one of the other works of the Company. This arrangement enabled some saving to be effected in the use of cannel, and a better quality of coke was obtained. The system still continues, and is found to be eminently satisfactory.

It will be seen that the two works are bound, to some extent, to co-operate, and regulate production to suit each other. Thus, excepting in cases of sudden emergency, the carburetted water-gas plant at Garston stands on a different footing from most similar plants, having to take its place throughout the year as a regular producer of a proportion of the gas needed for the city. This fact, coupled with the unique position of the Garston works as a carburetted water-gas factory purely and simply, has kept the working of the plant always baldly exposed to criticism, and at the same time the management has had no difficulty in constantly observing the exact degree of efficiency of every process. No doubt this, and the absence of diverting influences on the Superintendent's mind, has had much to do with the fact that the working at Garston has been continuously improved, in one respect or another, until now there is very little in the way of "problems yet to be solved," or "difficulties to be overcome." It is now proposed to particularize to some extent, and treat of the chief difficulties that have at various times arisen, and the manner in which they have been dealt with. During the fifteen years in which the works have been in operation, the author has been employed, in one capacity or another, in superintending the working of the plant under his esteemed father until fourteen months ago, when he had the honour of succeeding him as Superintendent; and therefore he is fully conversant with all that has been done.

To begin with the generating plant, the life of each set, from lighting up to letting down, used to be from six to eight weeks, because the walls of the generator, especially over the clinkering doors, were by that time burnt through, while other parts of the set would be in a fairly good condition. It was evident that this damage was caused by the draught at clinkering times; and it was decided to remedy it by reducing the pull at the stack. For some months clinkering was done with the stack-valve shut; and this met the case. But it rendered the clinkering process more arduous for the men, and somewhat dangerous. To meet this difficulty, auxiliary stack-valves, with holes in them (4½ inches diameter) were provided, and were found to be quite efficacious. The generator walls were still observed to fail first over the cleaning-doors—making it evident that cutting went on during the periods of working. But, by fixing heavy wrought-iron plates above the frames and on the fire-bar ends within the doorways, also by luting-up the opening with clay and ashes ground together, the fire was completely kept out of the doorways, and the generator walls were found to last some three to four times as long as before.

The lower hot-gas valve used to leak and give much trouble by corrosion on the face, owing to the wet acid dust which always lay about it. Also the steam introduced into the original rose nozzle seemed to please itself as to what part of the fire it entered; and uneven heating resulted. Both these troubles have been got over by taking in the steam supply at the side of the generator farthest from the blast inlet, leading it to the centre of the main bearer bar, and connecting it to four iron branch pipes, one along each side in each direction, perforated with holes, in such a manner as to drive the steam against all parts of the bottom of the fire.

It may be observed, in passing, that we have very little belief in down-runs; and if good fuel could always be ensured, they would be abolished altogether at Garston, as an unnecessary complication of the plant, and a means of unduly punishing the fire-bars. Two sets were worked for more than a month last winter without making a down-run, and no ill-effect was observed until some indifferent coke came along, which made two down-runs necessary per twelve hours to lower the clinker in the fire. This convenience is the only justification for not ripping out that vulnerable portion of the plant. As it is, the "uptake-pipe" has been altered, and it acts as a trap for the dust and fliers that otherwise would pass with the blast from the generator to the carburettor. The present practice is to make only one down-run in twelve hours (the period between clinkering times); and the

fire keeps hot right down to the clinker, which is, however, cool enough to be easily broken up and removed. To keep the chequerwork clean long enough to last the 24 weeks, which is now the average life of the generators, advantage is taken of every moment that a set is shut down to burn off the carbon by leaving the sight-cocks open and the covers off. It is remarkable how effective the induced cold air is in cleaning the bricks and maintaining the heats during an idle week-end.

Most of the dust or breeze which blows past the down-run pipe finds its way out of the stack, and, with the degraded hydrocarbons from the oil-soaked bricks, used to cause much hostile comment in the district; and the gutters and down-spouts of the roofs required constant attention. Something like 98 per cent. of this dust, as well as most of the smell, is now eliminated from the blast products by an arrangement supplied nearly two years ago by Messrs. Humphreys and Glasgow, by which the gases are led into a U-pipe, erected on the roof of the generator-house, in the downward leg of which a special water spray is inserted, which wets the dust, and washes it down into a sludge-tank; the gases escaping at the upward leg in a comparatively innocuous state. The amount of sludge obtained varies according to the quality of the coke; but it may be taken as, in the moist state, from 1 to 2 per cent. of the coke used. The worst feature about this arrangement is the rapidity with which the combined scouring and solvent action of the liquor destroys the cast-iron pipes, which had to be replaced within the first year by a square pitch-pine pipe, braced (perhaps an earthenware pipe would be better, excepting for the danger of fracture by shock), which pipe is still in use, and quite tight.

The water is supplied by a small pump on the operating floor, fitted with relief-valves, &c.; and the regulation is made by a special cock, geared to the generator blast valve-rod, which cuts off the water during the run. All who have experience of carburetted water-gas plant know how quickly carbon grows on the inside of the take-off pipes, especially if the heats are high, the oil coarse, or the pressures heavy, or if the illuminating power of the gas made has to be high, as at Garston. Yet the full 24 weeks are worked without opening out, except down near the seal, which is cleaned out every five weeks, when the washer is emptied. Acting on a suggestion made by Mr. Owens, of Messrs. Humphreys and Glasgow, the carbon deposited during each "run" is burnt out during the following "blow" by means of a small jet of air (controlled by the lever operating the stack-valve), which enters the pipe half-way down, and which has to be cleared of tar, &c., where it enters the take-off pipe, (say) once in 24 hours.

When using oil-heaters at Garston, several difficulties and one or two accidents occurred. They were therefore dispensed with altogether some eight years ago; and there has been no reason to regret the step taken. With some oils, as, for instance, the Texan, a scale formed on the inner surface of the heater, which, when grown to a certain thickness, chipped off, and fell into the lower neck, causing obstruction to the flow of oil, and upsetting the sprays, &c. Moreover, the space occupied by the heaters could ill be spared in a situation where free-way is necessary; and where the tendency is for stoppage to occur through furring. The use of heaters undoubtedly causes complication; and as there is no practical difficulty in cracking the full amount of any kind of oil when supplied to the carburettor in a cold condition, the plant is better without them.

Some four years ago, the opinion was formed that it was a mistake to make carburetted water gas in a vessel under pressure, almost as much as it was in the case of coal gas in a retort; and some time was spent in investigating the plant, to find out just where the pressure came from, and how it might be relieved. The pressure in the generator was about 18 inches, and the daily make of gas about 900,000 cubic feet per set. The conclusion arrived at was that the whole trouble was caused by the seal, which offered considerable resistance to the flow of the gas from the take-off. In the first place, the seal was reduced to the smallest safe limit; and then, by using a weir instead of a round pipe for the overflow, it was found possible to work with a variation of $\frac{3}{8}$ inch, whereas $2\frac{1}{2}$ inches was the previous amount. The effect produced, however, was not so much reduced pressure in the set as increased capacity, and further steps were taken. The opinion was formed that an increase in the circumference of the bottom of the take-off pipe would permit the gas to pass through the water of the seal-pot with greater ease. This simply meant hanging a trumpet or bell-mouth on the bottom end of the shortened pipe, which was done in June, 1908. At once the make of gas went up and the pressure down; and since then there has been no difficulty in regularly turning out about 1,100,000 cubic feet per set per day, or nearly 40 per cent. more than the plant was originally designed for—the pressures being less than one-half what they used to be. The fact that the seal-pot is now quite silent, whereas it used to rumble and bubble like a boiling cauldron, proves that the gas now passes clean across the depressed surface of the liquor, which levels-up again at the moment of opening the stack-valve. It must be stated that neither at any time during the experiments nor since has there been the slightest appearance of back gas. The relief holder was subsequently counterbalanced; and this made the seal safer, and also helped to remove the gas as fast as it was produced. Considerable economy in manufacture has by these means undoubtedly been accomplished.

Trouble was experienced some years ago with the pitching-up of the wooden battens with which the scrubbers were fitted; and these were replaced by 5 in. by $\frac{1}{2}$ in. boards, placed on edge, with $\frac{1}{2}$ inch spaces. The latter kept perfectly clear for years, but certainly removed very little tar from the gas. Three years ago, in an endeavour to reduce the amount of heavy tar carried forward to the condensers, a return was made to the original design of filling; using $1\frac{1}{4}$ inch square wood ribs, arranged chequerwise. A continuous spray of water removes the tar arrested by the wood ribs; and, so far, the arrangement is quite satisfactory.

After a set had been idling some hours, the water in the primary or water-tube condensers used to get very cold, especially in winter time; and this reduced the quality of the gas made when the set was put to work again. The difficulty was overcome by abolishing the use of water at that point, and admitting a natural draught of air, regulated by dampers; and this has been found quite efficient during the past twelve months.

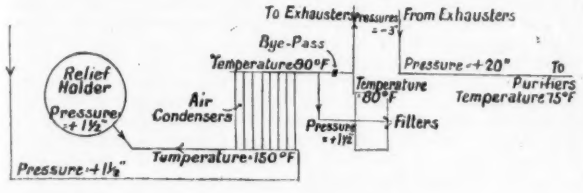
Another matter, and one of the greatest importance, is the system of complete purification best suited, for convenience and economy, for dealing with a high quality carburetted water gas. The original practice was to pass the whole of the gas, after being dealt with by the primary scrubbers and condensers, through plain pipe condensers, and to reduce it to the temperature of the air at the condenser outlets. It was then taken through the relief gasholder to the exhausters, and consequently during the winter season the gas was "starved," so that it was very difficult and expensive to maintain the standard illuminating power; while a large quantity of tar-fog was still carried forward, to the detriment of the oxide in the first purifiers. The problem was how to retain the illuminating power without permitting tar to go forward, or, in other words, how to get the tar out and leave the quality in.

An endeavour to knock the tar out at the air condensers by introducing perforated steel discs in their outlets, resulted in back-pressure being thrown on the set; so it was decided to put the condensers direct on the exhauster inlet, and thus pull the gas through—the relief holder simply balancing the varying make, and maintaining a regular flow through the plant. In this way the bulk of the gas misses the relief holder altogether; the only fault being that more condensers had to be put on one day than another, according to the weather, and this affected the tar-extracting efficiency of the discs, because of the varying rate of flow. When frost came, the tar in the discs became so thick that the back-pressure went up from 4 to about 14 inches, threatening a stoppage; and the steaming of the discs, while giving some relief, caused naphthalene to go forward, and resulted in obstruction in the gas service pipes—a thing previously unknown at Garston. It was then decided to maintain a temperature of 70° to 75° Fahr. at this point by restricting the number of condensers used; and this enabled work to go on for six months at a time without the discs having to be cleaned. The oxide boxes became much more active; but still sufficient tar went forward to prevent the spent material from being of use to the vitriol maker. The oxide was clogged, so that a pressure of 12 to 15 inches was thrown by each box; and when a layer of the stuff burst, foul gas passed through the hole thus formed.

The next step was to remove the tar in the first purifier, by passing the gas through a layer of material which would be close, and yet non-porous, so as not to clog. Clinkers were used for this purpose, graded as follows: A 3-inch layer of $1\frac{1}{2}$-inch cubes, a 14-inch layer of $\frac{3}{4}$-inch cubes, and a 4-inch layer of ground clinker blinding, placed one upon another to form a bed. This box was put in action in September, 1907, and worked until November, 1909; passing upwards of 1200 million cubic feet of gas, from which it removed almost every vestige of tar—throwing it off in the bottom of the box, where it escaped through a sealed drain-pipe. In the last few months of its life, the material began to make-up—the back-pressure from it rising from 4 to 20 inches. The result was to throw out nearly all the water vapour as well as the tar; and the expanded gas at the outlet of the filter so dried the oxide as to make it inactive after a few weeks' work. There was no duplicate box, and this particular purifier was needed for use with oxide.

The success of this experiment led to the provision of a pair of luteless boxes, each 10 ft. by 10 ft. by 5 ft., fixed in the open air, connected to the outlet of the condensers and the inlet to the exhausters; and these were fixed and ready for use at the end of October last. They were put to work, charged in a similar manner to the No. 1 purifier before mentioned, but with 6 inches of $1\frac{1}{2}$-inch, 6 inches of $\frac{3}{4}$-inch, 18 inches of $\frac{3}{8}$-inch, and only $\frac{1}{2}$ inch of fine blinding raked in. It was found that each box was capable of dealing with 2 million cubic feet per day, or 20,000 cubic feet per square foot per day; the pressure thrown being $4\frac{1}{2}$ inches. By keeping the temperature of the gas at 80° Fahr., the tar was separated in a condition liquid enough to run away. It was gratifying to find that, though the oxide boxes began to throw a little pressure, they seemed to get a new lease of life, showing that the pressure was not due to tar. The conclusion drawn was that the increase was attributable to the fact that, in knocking out the tar at higher temperature and lower pressure, more water vapour was going forward into the oxide boxes, helping to keep them in active condition; and the pressure was due to the separation of sulphur through the continuous revivification which is effected by allowing air to enter the filter outlet (where about 3 inches of vacuum exists) through automatic valves and calibrated cocks set to suit the make of gas. This opinion has been verified by the condition in which the oxide is now taken from the purifiers.

A rough diagram of the course of the gas is appended, with remarks as to the temperature and pressure obtaining at all the different parts of the system, when producing 2,200,000 cubic feet of 24½ candle gas per day.



It might be interesting to mention at this point an experience connected with the mixing of the gases for distribution. In drawing the necessary amount of coal gas from the Athol Street works for admixture with the carburetted water gas, one of Donkin's improved Beale type single two-bladed rotary exhausters is employed, of a capacity of 200,000 cubic feet per hour; and as this is usually worked at less than half its normal speed, driving the gas through a 125,000 cubic feet wet station meter only 10 yards away, one may very well imagine the degree of pulsation which occurred between the exhauster and the gasholder inlet, affecting both meters, which are placed side by side in the same house. In the month of November, 1903, the coal-gas meter ceased to register. On opening it for examination, it was found that several plates in the drum had started; and a large hole in one of the vanes seemed to indicate that at some time a shock had been unknowingly given to the meter. A thorough repair was made, and the meter put to work again in August, 1904; care being taken (by running the exhauster at 60 revolutions at all times, and by bye-passing a quantity of the gas to the inlet) to minimize as far as practicable the degree of fluctuation in the flow. In October, 1906, after working 26 months, the meter again broke down; and on inspection the drum was found to be worse than before—the stays being broken off, and the vanes and one of the cast-iron end blocks badly damaged.

The conclusion come to was that fatigue had taken place through the constant buckling of the sheets; and the drum had to be practically rebuilt. Inquiries as to the best means of getting over this trouble were made in many directions, but without success until Messrs. Thorp and Marsh took up the problem, and devised an arrangement in which a piston, working in a cylinder connected at one side to the inlet and at the other side to the outlet of the exhauster, and actuated by a shaped cam on the crank-shaft of the engine, absorbed the extra quantity of gas thrown out by each stroke of each blade, and giving it up again between the strokes. After careful adjustment, this arrangement (which, by the way, has been patented*) was found to give a continuous flow of gas from the exhauster in regular volumes at all speeds, from 25 to 75 revolutions per minute. The meter was put into action in November, 1908, since which time not one cubic foot of gas has been bye-passed, and both meters are running quietly and satisfactorily. It is estimated that the fuel saved during the past fourteen months has just about paid all the expenses connected with the arrangement; and our Vice-President, Mr. Frank Thorp, is to be congratulated on the splendid success which has attended his efforts in the matter.

In the discussion which ensued, Mr. Carter answered the questions as they arose. In reply to Mr. Alsop, he explained the advantage of the false stack bar, and, with the aid of the blackboard, showed how it was fixed. With reference to a query about the ash that was made, he said that it all depended on the quality of the coke supplied. In his case, it worked out at about 6 per cent., though he had known it run up to 8 per cent. The time occupied in clinkering was from 18 to 20 minutes; and eight men were required for the purpose. Replying to Mr. Woodhead, who said that in the making of a high-grade gas he found a great deal of carbon had to be dealt with, Mr. Carter said that at Garston they burned off the carbon. In regard to the temperature of the gas at the condenser, he knew of a case in which it was over 100°, with a report of increased efficiency. When they had more than two sets working, they had always two filters in use. As to steam pressure, he would work up to 130 lbs., because, in his opinion, 120 lbs. was not enough to keep the steam dry. Replying to Mr. Buckley, who asked the author how much naphthalene he found in his water gas, and how much of it went forward, Mr. Carter said the naphthalene varied very much, but, as a rule, it came out at about 5 per cent., and he had no reason to suppose any naphthalene went forward. Answering a further question about the oil spray, Mr. Carter said he had a Brighton spray presented to him the previous day. He had been asked to examine it, and give an opinion on it. The examination had, however, not yet been made. Mr. Carter went on to explain the spray that he has in use at Garston. This consists of a spindle in the centre of the tube, and a disc with diagonal holes in it, and rotating distributes the oil.

On the motion of Mr. J. Taylor, seconded by Mr. Wrigley, a vote of thanks was passed to Mr. Carter for his paper.

This concluded the proceedings.

* See "JOURNAL" for April 21, 1908, p. 170.

YORKSHIRE JUNIOR GAS ASSOCIATION.

Whenever a Junior Association can arrange a visit to their President's works, the fixture is always anticipated with pleasure, and attracts a good attendance. The position of the Yorkshire Juniors' President, as Manager of the Frizinghall Chemical Works of the Bradford Gas Committee, afforded the members the opportunity of a visit of great interest, somewhat off the beaten track. A goodly number assembled at the works last Saturday, and were shown round in small parties by Mr. S. W. Shepherd, his Chief Assistant, Mr. Percy Ward, and other members of the staff. A detailed description of the works appeared in these columns [Vol. CII., p. 565], when the Manchester District Institution of Gas Engineers visited them.

The works consist of a sulphuric acid plant and an ammonia plant, and deal solely with the oxide and liquor from the various stations of the Bradford Gas Committee. The visitors were all struck with the neatness and compactness of the works, and the signs (very evident to those who were somewhat familiar with these works) of constant improvements. Emphatically no "resting on the oars" prevails here. Various minor products have been made from time to time as a demand was found or created for them, and made only so long as remunerative, after which time inventiveness and alertness on the part of the management soon has new processes at work. In the two main departments, the aim has evidently been so to modify and improve the plant as to make a smaller one than usual suffice for a given amount of work, by bringing it to a very high state of efficiency.

The sulphuric acid plant was first inspected. About one-third of the total make of acid is used for sulphate of ammonia; while all the remainder goes to the neighbouring sewage works—being forced there through pipes by compressed air. The use of sulphuric acid for "cracking" the soap dissolved in sewage and waste effluents is common in the West Riding textile districts, and especially in Bradford. Many of the larger works treat their own effluents, in order thus to recover the fatty acids of the soap—the product being known in the oil trade as "Yorkshire grease." One Bradford works alone—and that not the largest—recovers nearly £6000 worth a year; while the inferior quality obtained from the crude sewage brings a return of about £12,000 a year to the Corporation. The chemical works are fortunate, not only in thus having but one customer for their acid, but in not having the trouble of concentrating it, packing it in carboys, and conveying it by rail or road.

In going round, the absence of the usual tall chimney was pointed out; the movement of the gases through the whole vitriol plant and the intake of air at the ovens being secured not by chimney draught, but by the action of a Kestner acid-resisting exhauster placed after the last chamber, and capable of passing 2000 cubic feet per minute. In recent years, the capacity of the plant has been greatly increased; and this has been secured with but little increase of chamber-room by the adoption of three sets of condensing or scrubbing towers intermediate to the chambers. These resemble small board-filled scrubbers on a gas-works, only glass plates of ¼-inch thickness, ⅛ inch apart, and 4 inches broad are used instead of boards, giving a much greater surface for a given cubical space than any other scrubber filling (26 square feet per cubic foot). These have a high efficiency, and condense 20 per cent. of the acid, though having a capacity of only 1 per cent. of the total chamber space. The Gay-Lussac or nitre absorbing towers are similarly filled, and are therefore only of about one-fifth of the size necessary with older-fashioned fillings, such as coke. This improvement, patented from these works, may be of interest to some gas-works whose tower-scrubbers are falling behind the requirements of an increased make.

Another recent improvement was noticed in the introduction of fused silica channels for the passage of the hot, strong acid. This new ware answers well, resists strong acid at a very high temperature, and is uninjured by any sudden and considerable changes of temperature. It seems likely to be generally adopted in such places, in spite of its rather high prime cost. The same high efficiency of compact plant was noticeable also when the ammonia houses were examined; the exceptionally small size of a free ammonia still capable of dealing with 100 tons of liquor a day being much commented on. This is of special construction, and was also designed by Mr. Shepherd, in conjunction with the late Manager, Mr. W. Wyld. All the liquor from the Bradford Gas-Works is delivered here by gravitation through pipes. As Mr. Shepherd's subsequent address would lead one to expect, much care and watchfulness are expended on all details of the plant; and many striking economies and successful precautions were quoted. The boiler water is softened on the works; and its preheating by the heat remaining in the waste gases after the raw liquor has been warmed up, and by the economizer, effects a very large saving in fuel.

New to many of the visitors was the muriate of ammonia plant; and it came in for close and interested examination. The production of this salt has long been a special feature of the works. Sulphate plant can hardly be inspected without inquiries as to blue salt, effluents, &c. At Frizinghall, blue salt rarely occurs—largely owing, in all probability, to the cyanide recovery process employed on most of the Bradford works, as ammonium cyanide, which the Chief Inspector under the Alkali Acts regards as the usual source of the trouble, is absent from the liquors here treated. The bacterial beds for the purification of the spent liquor and elimination

of its cyanide compounds, which were referred to later in Mr. Shepherd's address, were pointed out, although the heavy rain prevented much examination of them.

The members reassembled after going round the works, and adjourned to a neighbouring school for the delivery of Mr. Shepherd's Presidential Address.

The PRESIDENT then delivered his

INAUGURAL ADDRESS.

It opened with an exhortation to his colleagues, as members of an Association formed for mutual improvement, to communicate to each other their acquired knowledge, whether as the result of success or failure, in the form of papers for their meetings. He urged them not to be diffident, and pointed out that if they had mastered a difficulty, the relation of their experience might be of valuable assistance to others. Having this in mind when thinking over the subject of his address, he decided to offer a few observations on the recovery of ammonia, and the making of it into sulphate; this being the only portion of gas-works practice with which he was in touch. He then proceeded as follows:

In looking over the returns of gas undertakings as published from time to time, I have always been surprised by the great difference in the amount of ammonia recovered between one undertaking and another; the difference between the highest and the lowest being more than may be accounted for by quality of coal or methods of carbonization. The yield of ammonia obviously is dependent upon the nitrogen content of the coal carbonized; and the difference between the theoretical and practical yield is so astonishing that I trust I may be permitted to allude to it for a moment. In Newbigging's "Handbook" are given analyses of 53 samples of coal from different mines, the average nitrogen content of which is 1·33 per cent.; and if the whole of this nitrogen were recovered as ammonia, it would yield 140 lbs. of sulphate (24½ per cent. of ammonia) per ton of coal. The experiments of Professor Foster and others on the distribution of nitrogen in the distillation of coal showed that about 80 per cent. of the nitrogen is to be found in the gas and coke. Of the total nitrogen of the coal, four-fifths are gone beyond recovery. In view of the address delivered to the British Association by one of its Past-Presidents on the future of the world's wheat supply and its dependence on nitrogenous material, gas-works chemists have here a wide field for research. It has been said that he who causes two blades of grass to grow where before there was only one is a benefactor to his race; and if that be so, what racial gratitude must be due to him who causes two ears of corn to grow in place of one. That such nitrogen may be recovered we have ample proof; for, in the production of Mond gas, 90 lbs. of sulphate of ammonia per ton of coal are obtained, while in the Young and Beilby vertical retorts for the distillation of shale, 125 lbs. of sulphate of ammonia have been got by steaming.

This leads to the point that methods of carbonization greatly influence the yield of ammonia; high heats leading to its decomposition, with formation of cyanogen. Mr. Charles Hunt found, as a result of experiments at Birmingham on the same coal, that with an increase in temperature of 100° Fahr. double the amount of cyanogen was obtained. Again, Mr. Ferguson Bell, in his paper read before the Institution of Gas Engineers last year, showed that, by doubling the weight of the charge and period of carbonization from six hours to twelve hours, the production of ammonia was increased by 17 per cent.; and, though not mentioned, it would probably be found to be partly at the expense of the cyanogen. In the results given of the working of some of the vertical retort systems, we find an increase in the amount of nitrogen recovered as ammonia; and it would appear, therefore, that a minor result of the latest developments in carbonizing plant and methods will be an increase in the quantity of ammonia recovered and a reduction in the amount of cyanogen—the latter possibly helping to balance the cyanide market, which has gone to pieces with the many attempts at recovery by gas-works.

To come back to the gas-works returns, what do we find in practice the yield of ammonia—or, rather, what I am more particularly concerned with in this address, the yield of sulphate of ammonia—to be? Taking the last published returns, I find the average of 51 gas undertakings returning their recovered ammonia as sulphate to be 24 lbs. per ton of coal; and while more than 50 per cent. are below this figure, 18 per cent. are actually below 20 lbs. If, then, 24 lbs. is an average yield, having regard to varying qualities of coal and differential practice in carbonization, I venture to suggest that, by care and vigilance, the average of 20 lbs. returned by the 50 per cent. who are below the average could be increased.

I will now proceed to point out certain places where, in my opinion, leakage may be found, and where the organization of a systematic and careful oversight will be amply repaid by an increased yield of the ammonia residual. The pipes conveying liquor underground should be carried in brick or concrete channels, the covers of which should be easily removable for inspection. The store-tanks and seal-pots should be quite tight and covered in; ammonia being very readily evolved from its solutions, even at atmospheric temperature. If the surface of the liquor be agitated or disturbed by such liquor being dropped in from an open pipe-end, the evolution of ammonia is accelerated; and it is advisable to dip the pipe in the liquor whenever possible. With regard to this, I remember seeing some time ago the report of a speech by the late Sir George Livesey, at a meeting of shareholders of the South Metropolitan Gas Company, that they had had that year an increase of £5000 in their receipts from residuals, not because of better prices, but by preventing waste and loss by evaporation. A thorough overhaul of the ammonia-recovery apparatus had taken place, and much care had been exercised to make all quite tight. This is confirmed by the returns of the Company—the amount of liquor recovered being always well over 30 gallons of 10-oz. per ton of coal; and yet there are other undertakings returning less than 20 gallons.

By the way, I should think that in this twentieth century we gas people might add to our dignity by ceasing to speak of "ounce strength." and value our liquor on its percentage of ammonia. *Apropos*, why do so many gas undertakings continue to sell their liquor on the unscientific valuation by a Twaddel test? Even the old-fashioned "ounce" valuation is often arrived at by multiplying the Twaddel test by two, the result of which is still "twaddle," and absolutely unreliable. If the "ounce" valuation is preferred, then let it be arrived at by a proper analysis.

Certain inefficiencies tending to leakage of ammonia in the washing and purification plant may well be looked for. Inefficient scrubbing and washing plant will be the means of passing ammonia into the purifiers, where it is quite lost to the revenue account, and is the cause of considerable trouble to the purchaser of the spent oxide. I have often found in it 0·4 to 0·6 per cent. of ammonia; the latter figure causing great inconvenience and heavy consumption of nitrate of soda in the manufacture of sulphuric acid. Most acid manufacturers, when buying spent oxide, will claim an allowance for, or even refuse a parcel containing, an excess of ammonia. It is therefore necessary to watch the efficiency of the washing plant, not only on account of loss of ammonia, but also loss of revenue from the spent oxide.

Now as to working-up the liquor for the manufacture of sulphate of ammonia. It is my firm opinion that the real secret of low returns is a lack of vigilance while the sulphate plant is working, and that in many cases, if the profit on sulphate making turns out better than the former revenue when selling liquor, the management appears to be satisfied that all is well. This has been confirmed by two or three instances which have come under my personal notice, where, even under such circumstances, heavy losses of ammonia were taking place. The spent liquor from the stills should be very frequently tested for ammonia, and should never exceed 0·02 per cent. of ammonia. If higher than this, the cause should be looked for at once and remedied. A common error is that of exceeding the capacity of the stills, perhaps because there is a shortage of liquor storage, or one has a false notion that, by working up the stock quickly, the working expenses are reduced, forgetful of the fact that loss of ammonia may be taking place that will quickly swamp the reduction.

When this error has been pointed out, one has been met by the remark: "Why, the plant is of such-and-such capacity." That may be so; and the named capacity might hold good when the stills were new, but will not do for all time. When all is new and clean, the plant may be run at its maximum capacity without loss; but after several "runs," with long intervals between, the overflows and bubbling-hoods of the lime-still receive a coating of lime which on cooling sets hard, and this builds up after each stoppage—every layer built up reducing the contractor's guaranteed maximum capacity. It is necessary, therefore, to regulate the supply of liquor according to the result of the spent-liquor test; and this should be made by apparatus more scientific than a workman's sense of smell, which, sometimes, especially in the night, is wont to become dormant.

Another point to watch is regulating the lime supply. Here again rule-of-thumb is often in evidence. I remember once asking the attendant of a small plant how often lime was admitted. "Oh, just when we think fit," was his reply. A continuous feed is, of course, the ideal; but it is difficult to arrange in small plants, though I do not see why a small wall pump should not be used. If its duty was too high for the plant, it could have a bye-pass on the delivery, to return the surplus to the lime-tank, and it would also serve as an agitator. In order to find whether the liming periods are satisfactory, I would suggest that frequent samples of the spent liquor be drawn immediately before the lime is admitted, and distilled in the laboratory in duplicate—one without and the other with the addition of lime. If the latter yields a higher result, then, of course, the inference is that more lime is required in the still; and this should at once receive attention. A chart containing these tests and the time of liming (say) for a whole day would then show whether such periods are frequent enough. While speaking of stills, perhaps I may be permitted to point out the advisability of having pressure-gauges fixed to them; or, if these are considered superfluous, some form of safety-valve or pressure-box might be employed to relieve excessive pressure in case of blockage.

The "devil liquor" (which is the technical name for the condensed liquor from the saturator waste gases) should give an acid reaction to litmus paper; but if the latter turns blue, then ammonia is passing the saturator, or there is a leakage of liquor in the superheater. The waste-gas pipe from the saturator should have a tubulure and plug, in order that the gas may be tested frequently by litmus paper. If no alkaline reaction shows here, then either the trouble is over for the time being, and must be carefully watched, or the superheater is the source of trouble. If the alkalinity of the waste gases appears just after "fishing," the chances are that the saturator is too near being neutral; and as concentrated solutions of ammonia salts when hot dissociate,

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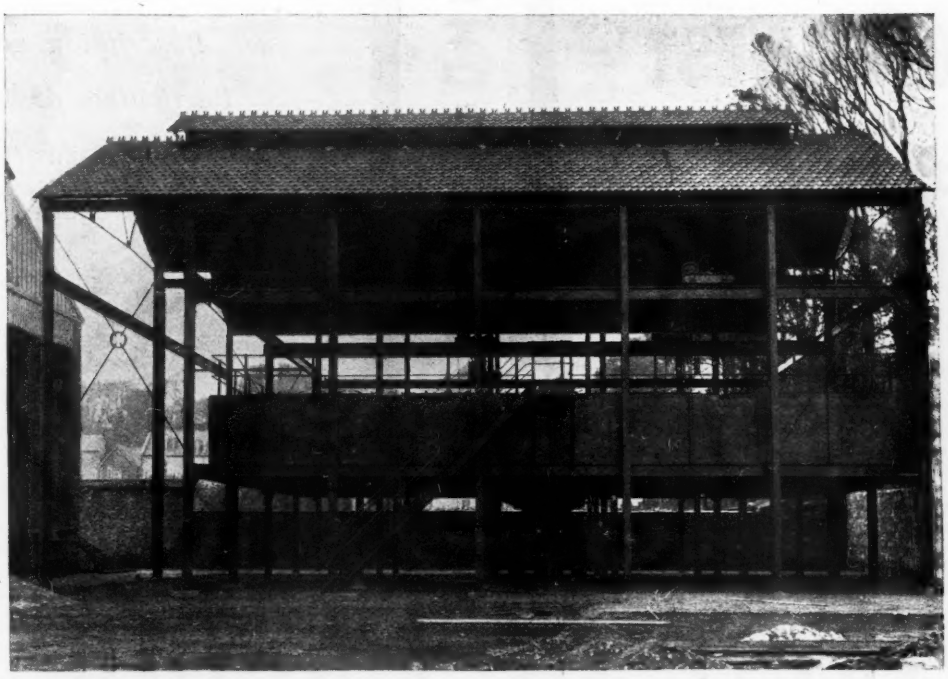

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giving off their ammonia, there is always a danger while "fishing" of the hot acid (what little there is of it at such time) being unable to retain the ammonia passing into the saturator. It is advisable, therefore, to have in the ammonia-pipe many small holes rather than few large ones, for the smaller the bubbles of gas, the better the opportunity for efficient absorption. Should the saturator be quite acid, and there is no reason to suppose the ammonia-pipe is burst, the trouble is no doubt caused by an incrustation of sulphate building-up on the pipe, and forming a kind of annular tube which allows a portion of the ammonia gas to pass beyond the level of the acid. This is a frequent source of trouble, and, when first noticed, steps should at once be taken to clear it, as much ammonia may be lost in this way if allowed to continue. To clear, dilute the saturator with water, and stop the supply of liquor to the stills; keeping the steam on as usual. This will "boil up" the saturator, and eventually dissolve the incrustation. I have found it a good plan to perform this operation once a week; and I rarely experience the trouble of ammonia passing from the above cause—the saturator keeping very clean. I would suggest that this should be done every time the liquor stock is worked up, just prior to shutting down the plant; and at the same time one should also arrange to turn a good flow of water down the stills when the liquor is shut off. This will assist in washing out the particles of lime while the still is hot, and will minimize the before-mentioned incrustation of lime in the stills.

In bringing under your notice my observations on the difficulties liable to crop up in sulphate making, I must not leave out the question of "blue salts;" for what manager or person in charge of a sulphate plant has not, at some time or another, experienced this trouble. Happily much useful investigation has been carried on in this field, and the pitfalls are now pretty well known. The essential factor for the formation of "blue salts" is the presence of ferrocyanides in the saturator; and this has been accounted for in two ways. Some chemists claim that disorganization of the plant, bringing about a neutral or alkaline saturator, is the cause; while others say it is "priming" of the still—that is, liquor passing from the still to the saturator along the pipe conveying the gases. Both are quite right; and, according to certain conditions, one or the other may be the seat of the trouble. At the same time, I have seen "blue salts" formed when the saturator has never been other than normally acid; and I have also seen an alkaline saturator many times without the formation of "blue salts." The conditions for the first cause are the presence of ammonium cyanide in the liquor and the presence of iron, which is invariably found in the acid. The saturator must be neutral or alkaline, and if cooler than usual, so much the better for the "blue salts," for more cyanogen will be retained in the saturator liquor.

The reactions take place in the following manner: If the saturator is neutral or alkaline, the iron in the acid is precipitated by the sulphuretted hydrogen, and reacts on the volatilized ammonium cyanide in the gases from the still, forming ammonium ferrocyanide—

$$6NH_4CN + FeS = (NH_4)_4\,Fe(CN)_6 + (NH_4)_2S.$$

Ammonium ferrocyanide is quite stable, both in alkaline and acid solutions; and when the normal conditions are resumed, correcting the alkalinity of the saturator, the iron salts are redissolved, and the ammonium ferrocyanide is converted into ferrous ferrocyanide—

$$(NH_4)_4\,Fe(CN)_6 + 2FeSO_4 = Fe_2Fe(CN)_6 + 2(NH_4)_2\,SO_4$$

which is a white salt, gradually oxidized on exposure to the air into the ferric ferrocyanide (prussian blue). This, then, is why sometimes an apparently white sulphate is changed on standing to a beautiful "blue;" and when the manager seeks to diagnose the cause of his blue salt, behold the saturator is working quite normal. On attempting to imitate these reactions in the laboratory, I was faced with the difficulty of being unable to obtain a blue sulphate, even though my saturator solution was alkaline and quite cold; and on examination of the sample of gas liquor used I found it did not contain a trace of ammonium cyanide.

The Chief Inspector of Alkali Works, in his investigations on the constitution of ammoniacal liquors, has shown (see Fortieth Report, p. 34, and Forty-Second Report, p. 26) that polysulphides of ammonia react with ammonium cyanide, forming ammonium sulphocyanide, and that excess of either implies absence of the other—

$$(NH_4)_2\,S_2 + NH_4CN = NH_4CNS + (NH_4)_2\,S.$$

In the case of the sample of liquor just mentioned, the absence of ammonium cyanide is quite accounted for in this way. The polysulphide method of cyanide extraction is in use at several Bradford Gas-Works, and consequently an excess of ammonium polysulphide is present in the liquor received at the Chemical Works. The same reason also accounts for my not finding "blue salts" when the saturator has been alkaline.

"Priming" may occur in such quantity as to cause the saturator to become neutral or alkaline, in which case the before-mentioned reactions take place, provided, of course, the liquor contains ammonium cyanide. If it contains ferrocyanide of ammonia, then, should the still "prime" with the saturator working under quite normal conditions, the result is bound to be "blue salts." Some liquors do not contain ammonium ferrocyanide; but that at Bradford contains from 10 to 15 per cent. of the total cyanides present in the form of the ferrocyanide. The iron in our acid being invariably in the ferric condition, when "priming" takes place, we obtain prussian blue as a primary reaction—

$$3(NH_4)_4Fe(CN)_6 + 2\,Fe_2(SO_4)_3 = Fe_4(FeCN_6)_3 + 6\,(NH_4)_2\,SO_4.$$

In this case, the salts are coloured when removed from the saturator, and "blue salts" are obtained, even though working the saturator under quite normal conditions, should the still "prime" into the saturator.

The sulphate may sometimes have a yellow colour, which is due to the presence of arsenic sulphide; this being precipitated from the acid in the saturator by sulphuretted hydrogen. If the acid being used is supposed to be "arsenic free," the inference is that a consignment of arsenic acid has been received. With an open saturator, it is quite possible to use the cheaper pyrites acid without affecting the colour of the sulphate. This is done by running into the saturator a little heavy tar oil along with the acid, and this carries the arsenic sulphide to the surface as it is precipitated, and must be continuously skimmed off.

The difficulties mentioned up to now are all such that with care they may be quite overcome; but I come now to a trouble of the sulphate manufacturer which has arisen within recent years. I refer to the disposal of his spent liquor. Happy were the days of old when such effluents were turned into the nearest watercourse or sewer, and there was none to say nay. But, alas for the peace of mind of manufacturers in general and of sulphate makers in particular, those days now belong to the "good old times." Though the Rivers Pollution Prevention Act was passed in 1876, it is only within quite recent years that anything has been done in the way of enforcing its provisions. The consequence is that where spent liquor was formerly frequently discharged into a watercourse, the distiller is called upon to stop his pollution. If he is discharging it into a sewer, the local authority are on his track to keep it out, as they find difficulty in conforming to the provisions of the Act because of its admission.

Of course, it is quite easy to provide settling-tanks for the lime sludge and cooling-tanks—indeed, this is necessary, because if the spent liquor went into the sewers hot, poisonous gases might be generated, causing danger along the sewer line. But having done all this, the polluting effect of the clarified liquor, judged by the "oxygen absorption" test, which is the standard at present applied to sewage and trade effluents, is enormous. When I mention that the spent liquor may require anything between 300 to 600 (I have even heard of 900) parts of oxygen per 100,000 to completely oxidize it, whereas crude sewage requires seldom more than 10 parts per 100,000, and that the spent liquor from the Frizinghall Works is only about 0·25 per cent. of the dry-weather flow of Bradford sewage—and even this small quantity is sufficient to increase the strength of the sewage by about 12 per cent.—you will readily understand that the less a local authority having such works in their district have to do with their spent liquor the better able are they to conform to the provisions of the Rivers Pollution Prevention Act. Owing to pressure brought to bear upon ammonia distillers, many attempts have been made, with more or less success—certainly less than more—to render spent liquor harmless for admission to a stream, for most processes have been banished to the limbo of forgotten things.

Unlike the majority of trade effluents, the one under consideration is not amenable to chemical treatment except by methods of precipitation whose cost rules them out of court; and even then the effluent is nowhere free from harmful constituents. The oxidizable matters in spent liquor are sulphocyanides, ferrocyanides, thiosulphates, and phenol compounds. All except the last may be removed by precipitation; and these may often account for 50 per cent. of the oxygen consumed. Dr. Skirrow, in a paper read before the Society of Chemical Industry, estimates that half the phenols evolved from the distillation of coal are found in spent liquor; so that another problem for investigation is how these phenols may be retained in the tar, thus causing the spent liquors to be less polluting. In order to precipitate sulphocyanides, an expensive salt like copper sulphate has to be used; and extreme care is necessary to prevent loss of precipitate and precipitant; and when obtained, there is practically no market for the copper sulphocyanide beyond what will yield smelter's value for the copper constituent, allowing nothing for the cyanide. The proper place for the recovery of cyanogen is from the gas and from the liquor before distillation; for where cyanogen recovery from the gas is practised, there is still the proportion of cyanogen which condenses out with the "virgin liquor." Evaporation of the spent liquor would ensure a more concentrated accumulation of cyanides. But again we are faced with a costly process, for with a low-class fuel the cost would be about 2s. 6d. per 1000 gallons; and though this could be reduced by vacuum evaporation, the capital outlay of such apparatus would be enormous. Experiments at Frizinghall showed that the distillate from vacuum evaporation consumed a much larger amount of oxygen than crude sewage.

Dr. Gilbert Fowler, of the Rivers Department of the Manchester Corporation, has for some time been carrying out experiments at Manchester on the bacteria treatment of spent liquor without admixture with sewage. It has always been thought that this liquor was not amenable to bacteria treatment on account of the presence of cyanides; but Dr. Fowler has proved conclusively that these may be broken down by bacteria under certain conditions. By diluting the spent liquor so that the oxygen absorption test is about 25 parts per 100,000, it is possible to run the diluted liquor on to a bacteria bed at the rate of at least 90 gallons per cubic yard per 24 hours; and the activity of the bed is maintained for a long period. Plans are under consideration for extending the filter-beds at the Manchester Corporation Gas-Works for treatment of the liquor before entering the sewers.

The Frizinghall spent liquor averages about 550 parts of oxygen absorbed per 100,000 and contains 0·3 per cent. of calcium sulphocyanide. A small filter was prepared according to Dr. Fowler's instructions, and the spent liquor diluted with fresh water from a neighbouring stream until the diluted liquor absorbed 25 parts of oxygen per 100,000. The capacity of the filter is 40 cubic yards, and consists of "clinker" graded in layers—rough at the bottom and fine at the top. The liquor was run on to the filter very slowly at first, and gradually increased, with periods of rest, until it is now possible to maintain a flow of 90 gallons per cubic yard per 24 hours, and a purification of 85 per cent. on the diluted liquor—the effluent being pure enough for the stream. The cyanogen compounds are quite eradicated—no traces being present in the effluent; and the phenols are reduced by more than 80 per cent.—showing that bacteria may be cultivated to do the work of purifying liquors containing such compounds. Owing to the geographical position of the spent liquor outfall, we are unable to send this to the sewage works; but if an effluent for admission to the sewers was required—say, a purification of only 60 per cent.—the flow per cubic yard could be considerably increased.

When the filter has been brought up to its proper condition, Dr. Fowler finds that the dilution of the spent liquor with the effluent from the filter is quite feasible; and in this case, of course, the purification is greatly increased. For instance, a spent liquor absorbing 500 parts of oxygen per 100,000, diluted with an effluent of 2·5 parts, and the purification of the effluent again brought to 2·5 parts, would mean a purification of 99½ per cent. Owing to difficulties over which we had no control, delay in maturing the filter has taken place; but now the experiments are proceeding, though it is too early yet to give any results. To show the advantage of treating the spent liquor on these lines, apart from mixing with sewage, I may mention that whereas when crude sewage is treated on bacteria beds for a purification of 85 per cent., 50 gallons per cubic yard per 24 hours is considered a good flow, Dr. Fowler's experiments show that by treating the liquor by itself, on the lines described above, a purification of 99½ per cent. can be obtained with a flow of 90 gallons per cubic yard per 24 hours.

The present state of the law regarding trade effluents is very unsatisfactory from the manufacturer's point of view; he being quite at the mercy of the local authorities. The Rivers Pollution Prevention Act provides that it is an offence against the Act to cause or knowingly permit any poisonous, noxious, or polluting liquor proceeding from a manufacturing process to flow into any stream. If such polluting liquid was passing into the stream prior to 1876, and it can be shown that the best practicable and reasonably available means are being used to render such liquid harmless, an offence against the Act is not committed. Proceedings are not to be taken without the consent of the Local Government Board, and such consent is not to be given unless the Board are satisfied that means for rendering harmless the polluting liquid are reasonably practicable and available, and that no material injury will be inflicted by such proceedings in the interests of the industry. By the Local Government Act of 1888, the powers for enforcing the Act were given to county councils and to joint committees of county councils and county boroughs. Such a Joint Committee is the West Riding Rivers Board, which is well known among sulphate makers in this part of the world. The Board consists of representatives from the West Riding County Council and the County Boroughs of Bradford, Leeds, Halifax, Huddersfield, and Sheffield, and has jurisdiction over all streams in these districts.

Unfortunately for the ammonia distiller, there are no reasonable or available means for the complete purification of his effluent; yet where he has been discharging it into a stream, he is informed that such discharge must cease, though to my knowledge no proceedings have been taken on account of pollution by spent liquor. If he endeavours to gain admission to the sewers of the local authority, the Act is against him if they choose to so read it. The Act provides that the local authority shall give facilities for enabling manufacturers within their district to carry their trade effluents into the sewers, "provided"—and here are the restricting conditions—that they would not injure the sewer, that they would not prejudicially affect the disposal of sewage, and that their volume is not too great for the capacity of the sewers. In the case of any trade effluent, therefore, a local authority wishful to evade their obligations under the Act are quite easily able to do so; and in the construction of a new system, they could even refuse to build sewers of sufficient capacity to admit trade effluents. With regard to spent ammoniacal liquor, no local authority in their normal senses would admit it to their sewers when, as I have already endeavoured to make clear, it has such a polluting effect; and any excuse may be found under the provisions of the Act just mentioned. The consequence is that some authorities allow trade effluents while others do not; some press for preliminary treatment, while other manufacturers go "scot free." This means unfair competition between people in the same trade; it being quite possible for two adjacent factories to be in different urban districts, the authorities of which hold different views on the Rivers Pollution Prevention Act. Of course, a manufacturer may take his case to a Court of Law. But such litigation is very costly, requiring expert witnesses; and the uncertainty of the result makes him hesitate at such a step. A local authority should seek to foster trade within their district, not to cripple it; and it should be compulsory on them to admit trade effluents into the sewers if manufacturers desire it.

Speaking generally, trade effluents can be treated in the aggregate with the sewage at a much less cost than by individual manufacturers, though I would make each pay his fair share of treatment. I understand that one District Council was faced with great difficulties by this spent liquor—it being about 10 per cent. of the dry-weather flow of the sewage; and the firm were allowed admission to the sewers by paying part of the extra cost of the filter-beds. By Dr. Fowler's method of treatment, a local authority would do better to erect filters at the ammonia works; the cost of treatment of the spent liquor being reduced thereby, as I have shown. It is gratifying to note that there is likelihood ere long of new legislation on this subject of sewage disposal and trade effluents—a Royal Commission having been inquiring into the question since 1898. Interim reports which have been issued point out that alterations to the existing law are necessary; and the appointment of a Central Authority is suggested. If such an authority be set up, whose officers are equal in kindness and courtesy to those appointed under the Alkali Acts, and have the same power to render assistance and give advice, then, as one who has occasion to come into close touch with these gentlemen, I can truly say that the manufacturer having trade effluents to dispose of has everything to gain and nothing to lose by the appointment of a Central Authority under the Rivers Pollution Prevention Act.

Gentlemen, I trust I have not wearied you by labouring this matter of trade effluents; but it is a question upon which I feel most strongly. The task I set myself is finished, and I thank you for your patient hearing of my somewhat disjointed remarks, wherein it has been my endeavour to show how, by attention to what may appear to be mere details, the output of the most valuable residual asset of a gas-works may be brought to its maximum.

Mr. F. SCHOLEFIELD (the Senior Vice-President), who occupied the chair, said that by his address Mr. Shepherd had further realized their expectations, and again shown what a good President the Association had. His address would not only prove a stimulus to their ingenuity and foresight, but would help them in the practical daily working of their plants. They could not at that late hour discuss the address, even if such a course were usual; but he should suggest that they would do well to return to the subject on an early occasion, and then ply the President with questions. They valued the privilege extended to them that afternoon in being permitted to visit the chemical works, and were grateful to the Bradford Gas Committee and their various officers.

Mr. J. H. HILL moved a vote of thanks to the Gas Committee and to Mr. Shepherd both for his address and for his arrangements for the works visit. He was sure that every one had appreciated the day's privileges, and had made this evident when going round the works. The works had impressed them all with neatness, compactness, and ingenuity seen everywhere, and with the notable absence of malodours. The address had been stimulating and informing, and its treatment of the question of effluents would prove especially valuable.

Mr. W. CRANFIELD seconded the vote. He knew Mr. Shepherd had had some hesitation in taking up a subject as hackneyed as sulphate-making was supposed to be; but he had justified all their expectations by delivering an address which would be of lasting value and helpfulness when printed in the Technical Press. So far from the subject being threadbare, a great variety of questions, theoretical and practical, arose from time to time to which it was difficult to find ready answers in books or periodicals. It was really a subject upon which many juniors were hard put to in gaining adequate and practical knowledge; and he was glad Mr. Shepherd had overcome any reluctance to handle the subject. He had been charmed with the lucidity, exactness, and literary excellence of the paper. As they were finding out, Mr. Shepherd had a happy gift of expressive phrasing; and his official appearances and utterances would amply justify their action in making him President.

After the vote had been enthusiastically passed,

Mr. SHEPHERD declared that he felt overwhelmed by their kindness; but if the little he had done was of any value or would be any credit to the Association, he was glad. He would frankly own that his reluctance to accept the office to which they had called him was largely because of the Presidential Address that would be expected of him. Many addresses had appeared in print that he felt himself incompetent to follow, as his association with gas-works practice was so limited. He had, however, resolved to confine himself to the branch of work in which his own experiences had been. Hence his choice of subject that day.

Councillor HORACE GELDARD, Chairman of the Bradford Gas Committee, said that on behalf of the Committee and himself he was much obliged for their vote. Permission to visit the works had been freely granted. He was pleased and gratified to hear their warm appreciation of Mr. Shepherd's address. He was proud of it himself, and proud of Mr. Shepherd, whose ability would bring him forward and make him widely known in future. He would not venture to talk "gas" to a company of experts, especially as three years ago when he was first made Chairman of a Committee managing a business with a capital of over a million pounds, he was comparatively a novice. He had, however, continuously taken great interest in gas matters, and was sometimes regarded as gas mad. In fact, it really was astonishing how keen an interest one could acquire in a new business when called to a responsible position.

SCOTTISH JUNIOR GAS ASSOCIATION.

EASTERN DISTRICT.

The Eastern District Division of the Scottish Junior Gas Association held a quarterly meeting in the Lecture-Room of the Museum at Perth on Saturday afternoon—Mr. H. RULE, of Falkirk, the President, in the chair. Considering the distance many members had to travel, and the bad weather prevailing, there was a good attendance—numbering nearly thirty.

The PRESIDENT expressed pleasure at seeing so large a muster of members, and the hope that those who had before the meeting visited the gas-works had seen something that had interested them. They were to have a paper from Mr. S. Butter, who was engaged at the works, on "Tar as a Preservative." As perhaps the members knew, at the Perth Gas-Works they went in for the distillation of the tar; so that he was sure what Mr. Butter had to say on the subject would be of interest, not only to themselves but to the gas industry in general.

Mr. S. M'N. BUTTER (Perth) then read the following paper on

COAL TAR AS A PRESERVATIVE.

The advent of the automobile has created a new market for tar and tar products, as the excessive wear of macadamized roads has turned the attention of road engineers to the necessity for a suitable binding material. Refined tar and mixtures of tar with other bituminous substances have been found to answer this purpose. Different conditions require different treatment, and each gas manager may specialize on the roads in his particular district; so that there is room here for initiative on the part of gas managers to prepare a suitable distillate. Road engineers in various localities are not only willing but anxious to experiment with different mixtures until they have found one to answer their purpose.

Mr. Thomas Aitken, the County Road Surveyor of Fife, the inventor of the pneumatic tar-spraying machine, is a pioneer in the use of tar; and he has given practical demonstrations of how to make and keep roads with tar as the binding material. The roads under his care are known far and near for the excellence of their surface and freedom from dust or mud.

Experts generally acknowledge that tar is the best binding medium available for dust prevention, durability, and cheapness. Before applying it to the road, the surface is thoroughly cleansed, in order to remove all loose bindings and extraneous matter. When this is properly done, and refined tar of good quality is used, applied in the form of a fine spray under pressure, at the rate of one gallon to 5 to 7 square yards, the tar is forced into the interstices of the road crust, forming a waterproof surface. This penetration is a very important factor in surface spraying, and may vary from ¾ inch to 2 inches in depth, according to the conditions of the road surface and the pressure employed when spraying with the machine.

For this class of work, ordinary refined tar may be used; but "tar compos" are preferable—that is, refined tar freed, as far as possible, of all deleterious constituents, including naphthalene, as a base, with bitumen or pitch added in certain proportions. This compo should form when cold a viscous, tough, flexible, and adhesive matrix, insoluble under ordinary conditions. Compo made from hard pitch revivified by the addition of light oil or creosote is of no use; the agglomerating properties of the pitch so treated being very deficient. In making tar macadam on a 4-inch coat of metal, 8 to 10 gallons of compo are generally used. With Mr. Aitken's pneumatic tar-sprayer, he gives three to five applications at a pressure of 250 lbs. per square inch; and this ensures constant and equal distribution. Compo of high viscosity is in no way detrimental to this spraying-machine, as the railway tank-waggons are generally fitted with steam coils, which are used to liquefy the material sufficiently to pump into the tank of the tar-sprayer.

A few of the best known tar compositions in the market at present are Clare's "Marbit" and "Tarvia;" but road engineers naturally ask: "Can anything better be produced for this class of work at a reasonable price?"

For the preparation of refined tar, expensive plant is not required. An old boiler shell and a suitable condenser will do. The heating can be accomplished either by means of close steam or by a coke furnace. When the water and naphtha are extracted, the tar is ready for use. For certain purposes, however, it is sometimes necessary to return part of the oil to reduce the viscosity. The naphtha obtained finds an ever-ready market at a fair price. The Perth plant, which was put down six years ago, turns out pitch and oils or refined tar according to the demand. The stills are of the English type. The condensers are of the ordinary worm type, water-cooled. The naphthalene catch-boxes and store-tanks are composed chiefly of old disused plant. The stills are gas-fired, with one producer and separate gas-ducts and valves to each still. Coke fuel is used.

In refining tar, the still is filled to within 3 feet of the top. This allows space for frothing, which occurs in the early stages, owing to the water contained in the crude tar. Tar with a large percentage of contained water must be handled with care, to avoid boiling over; but ordinary separation in the tar-well is generally sufficient to prevent any difficulty in this respect. A moderate heat is applied at the start, and continued until the water is expelled. It is at this stage that the tendency to boil over occurs unless this rule is observed. The firing can then be increased to 250° C. until all the naphtha has been taken off. The refined tar is then collected into store-tanks, and allowed to cool before being loaded for despatch.

The demand for tar for road spraying is increasing. During the summer of 1909, this demand caused a temporary rise in price. But unless suitable tar can be supplied at a reasonable figure, the development of tarred roads will be slow. Meantime, the policy of every gas department should be to foster road-tarring by selling tar at a price which will attract a steady demand.

A large and increasing number of the public are interested in this subject. They may be divided into three classes: (1) Those who use the roads for vehicular traffic; (2) pedestrians who suffer from the effects of dust clouds or mud thrown up by passing vehicles; and (3) dwellers on the public roads.

From remarks one occasionally hears, there seems to be an impression that tar roads mean tarry roads; and it is probable that those who have passed the Carse of Gowrie, and other places where the roads have been treated with tar, have been impressed with the contrast at the smooth, even surface, and resilience of the road, but have not realized that these results could have been obtained with coal tar. The beautiful brown, clean surface would suggest that the road had been treated with a fine colouring substance. This is caused by vaporizing the tar, and forcing the vapour into the roads at the high pressure mentioned, leaving no deposit whatever on the surface.

That tar-spraying has solved the dust problem there is no doubt. It has also improved the road surface and lengthened the life of the roads. The extra small initial outlay in this way is, therefore, amply repaid; and when once road authorities realize these advantages, tar roads will be general, and there will be less occasion for expensive causewaying, or for what has been known as tar macadam, with its treacherous surface.

In addition to all its other advantages, the sanitary aspect of the subject appeals to town dwellers. There is no road surface—wood block, granite, or whin sett—that can compete with the new tar-spraying on sanitary grounds; and in the end authorities must admit it to be the cheapest, most durable, and cleanest form of road-making that has ever been invented.

Discussion.

The PRESIDENT, in opening the discussion, remarked that the subject of the paper was one of great interest to everyone in the gas industry, not so much in regard to the treatment of roads, but because this provided another outlet for the sale of tar.

Mr. A. MORTON FYFFE (Dundee) said he had expected that Mr. Butter would have dealt with tar as a preservative in many ways; but he had confined himself to the most modern use of it. No doubt tar for road-making had a great future; but he scarcely agreed with the author of the paper when he spoke of tar roads superseding causewayed roads. In towns, where there was constant traffic, macadamized roads would not do. Tar put on such a road was a great advantage, as it lengthened the life of the road. There was also a great reduction of dust, as compared with an ordinary macadamized road. But in towns they must always have roads laid with whinstone or granite setts. At the same time he thought it was well that Mr. Butter had brought before them the fact that a field was open for tar for the purpose of road making.

Mr. R. B. CHALMERS (Alva) said that in his town they had done something in the way of getting people to use tar for making footpaths. They used two barrowfuls of ashes to a pailful of tar. They put down all the footpaths about the houses at the gas-works and also in the works, laying the macadam 5 inches thick, and with very good results. After this had stood the test of a winter, they went to some influential people in the town, and asked them to give the process a trial. Since then they had done a good trade in this line. They either made up the substance themselves at the works, or sold the tar and instructed the purchasers as to how to make it up. One contractor had made a tennis court with it. Another had laid a whole avenue, about a quarter-of-a-mile long, with it, and it had been a great success. It had cost absolutely nothing for repair; whereas formerly it was constantly in need of it. They were still pushing the system, and he hoped that before long they would have a good trade. They had not yet convinced the road authorities that spraying with tar was a good thing, but two or three members of the Town Council had been looking at tar-laid roads—roads laid with whinstone metal, rolled down, and the tar poured over it, and then covered with chips and rolled again.

Mr. R. W. COWIE (Dalkeith) stated that before coming to the meeting the use of tar for preserving roads did not enter so much into his mind as its employment for preserving woodwork. This certainly had not come before them lately, because, ever since gas was made, coal tar had been used for this purpose—probably at first as a substitute for paint; but it had been found to be a very good preservative of wood, especially of wood which was exposed to the elements. For roofing purposes, coal tar was largely used, as well as for making damp-proof courses in building. It preserved a building from damp and consequent decay—not only the wood but the stone. His experience of tar on roads had been somewhat limited; but at Lockerbie, on the main road between Glasgow and Carlisle, he persuaded the Road Surveyor to treat a considerable stretch of the road with it. It was fairly successful—at any rate, part of it. The portion which was successful was done in weather that had been good for two or three

weeks; that which was unsuccessful was done when the work was interrupted by rain. It was continued shortly after rain had ceased, with the result it did not last at all like the part that was tarred in good weather. It was treated in much the same fashion as Mr. Chalmers had explained—the road metal being laid on and rolled, and the tar put on as near boiling as possible, then covered with whinstone chips and sand, and rolled again. In the part which was done in wet weather, the tar did not seem to go down at all, and so caused considerable annoyance to users of motor cars as well as to all users of the road. It was well that the subject had been brought before them, because it would help to give them a better market for tar.

Mr. W. DUNLOP (Kirkcaldy) said he had had some experience in treating roads and garden paths with tar. In New Zealand they had cheap tar, and used it on various roads and footpaths, with varied results. In some places they produced splendid surfaces; in others they could not get the material to adhere or take-up. The conclusion they arrived at was that the subsoil had a good deal to do with the result. Where the bottom was open, and the tar got down, the road was good; but where there was clay, the tar did not seem to penetrate, and the work was practically a failure. Mr. Butter mentioned that, in preparing the tar, there was sometimes difficulty with it boiling over. He had seen tar which was very troublesome to treat in this way; and the difficulty was got over by blowing a small jet of air through the still.

Mr. R. B. WADDELL (Dunfermline) said that three summers ago he was in St. Andrews, where roads were treated with tar. They had a very fine surface, and when dry it was all right; but when it rained the roads were very slippery, and difficult to walk on. Just outside Dunfermline, however, a gentleman had laid a private road for about 500 yards with tar, and it was a good road—neither smooth nor rough, and not slippery on the surface. He was curious to know how this could be explained.

Mr. A. R. WILSON (Perth) thought it had been brought against the system of road making with tar that it was detrimental to fishing; but he considered that this objection might be removed by doing the work in dry weather, when the impurities on the surface would not be so liable to be carried away.

The PRESIDENT said Mr. Butter's excellent paper did not lend itself very much to controversy and discussion, but it nevertheless had indicated an outlet for a product which at present, at least in most gas-works, they had to hand over to the tar distiller, at whatever price he might like to give for it. It would have added very much to the value of the paper if the author had given them the cost of producing refined tar, and shown the profits to be derived from the adoption of plant to produce it. That was to say, supposing they got 8s. 6d. per 100 gallons from the tar distiller, how would it pay—say, in works making 25 million cubic feet of gas per annum—to put down the plant? What would the cost of working it be? For, after all, it really resolved itself into a matter of pounds, shillings, and pence for the gas manager. However much he might like to see a fine road for motoring, he was not going to work a process for refining tar unless it would pay him to do so. He had had the pleasure of going through the Perth Gas-Works that day, and certainly the tar plant there was of the simplest possible nature. He believed that in most works they could afford to have such a plant, even on a smaller scale. Where gas-works were in the hands of a town council, there should not be much difficulty in disposing of refined tar for the making of roads. It seemed to be only a question of persuading road authorities that treatment with tar was the best for roads. They were all agreed that such roads were much more pleasant to walk on than others, when motor-cars were passing. It would be a good thing if they could get the cost of a road made up in the ordinary way and one treated with tar. They should watch the development of the process; and if they could make more profit from their tar than they were doing, it would be their duty to prepare refined tar and put it on the market.

Mr. BUTTER thanked the speakers for their remarks on his paper. Mr. Dunlop had alluded to the difficulty of getting tar to penetrate the roadway in some instances. They would not be applying the tar under pressure. The roads he had spoken of had had the benefit of being treated under pressure, and in consequence the tar penetrated even the hardest road. It was not necessary to put down a large plant for the refining of tar. With that at Perth, they found they could earn 0·33d. per 1000 cubic feet of gas more than if they were selling the tar in the crude state. This worked out at about £300 a year.

The PRESIDENT invited Mr. M'Lusky, the Gas Engineer and Manager of the Perth Corporation, to address the meeting.

Mr. M'LUSKY expressed his pleasure in accepting the invitation. He said Mr. Morton Fyffe had made a remark about the relative strengths of square setts and of broken metal—from the same quarry he should say—that was to say, the relative resisting power of the two. But supposing they were to take whinstone, squared and laid, and the same whinstone, broken and rolled with a heavy roller, and bound together with a strong matrix of tar, he thought it had to be proved which was the stronger of the two. He was inclined to give way in this matter to Mr. Fyffe, who had had experience of road making, and he (the speaker) had not; but he would not like it to go out from that meeting that tar was weak in any respect. He would rather that it should be thought it was the very thing. If they thought that, probably they would get to perfection in road making by means of tar. For example, most of them were aware of the difference between Telford's and Macadam's methods of road making. The one believed in hand setting and the other did not. These two great authorities differed in this—that Telford, who set his bottoming by hand, was criticized by the followers of Macadam, on the ground that there was a want of even distribution of the metal with hand setting. Some of the stones were too big, and carried more weight, while others did not carry weight enough. Macadam, on the other hand, believed in making all his road with metal of a certain size—not in putting in great lumps. But they had to consider that in those days there were no road-rollers, and that without rolling the stones became loose and ran away from their work; they would fly away from below the wheel of a baker's van. When stones flew off in this way, they had the road in ruts; but when they employed tar, almost as pitch, and when they sprayed it into the road to a depth of about 2 inches, the stones were bound together, and could not move, rub against each other, or have their corners ground off and roll out. Every stone was flat-turned to the surface; and he believed that experience, down to the present, had shown that these roads were stronger than ordinary macadamized roads. He considered also that whinstone setts would no longer be necessary in rural districts. To his audience it might appear absurd to speak of whinstone setts in rural districts; but, as a matter of fact, in the Border district there were towns in which the side streets were causewayed for cleanliness. A road made up with good macadam, and bound with a tar matrix, would, for all purposes, be better and also cheaper than one laid with whinstone setts. Mr. Waddell said he had come across a very slippery surface made by tar spraying; but he (Mr. M'Lusky) understood that road engineers were now able to produce either a rough or smooth surface to order. It was altogether a question of the density of the tar and the number of applications. As a matter of fact, if a very heavy tar were taken, and a certain number of coats of it were laid, it could be brought up to quite a glossy surface. But ordinary tar spraying left not the slightest suspicion of tar having been used; it made a brown opaque surface. It differed entirely from tar put on with a brush, which he understood was the method of applying it in Kent—men pouring on the tar hot, and others following with brushes; but this was not the same as spraying with tar.

The PRESIDENT said he was sure they had all appreciated very much Mr. M'Lusky's remarks, as well as Mr. Butter's valuable paper. He asked the meeting to accord to the author a very hearty vote of thanks for the trouble he had taken in preparing it.

At the close of the meeting, the company were taken to the Perth Laundry, owned by Bailie Robert Hamilton, the late Convener of the Corporation Gas Committee, where they were shown a most perfect system of lighting by incandescent gas, with inverted burners. A Keith rotary compressor, driven by a gas-engine, is employed to compress the gas to a pressure of 64 inches. The lighting effect was admirable. Besides lighting, gas is also used in the laundry for the heating of the irons and the rollers of the calendering-machines.

On the return to the city, tea was served. Ex-Bailie Macpherson, the Convener of the Gas Committee, presided, and there were present a number of members of the Gas Committee.

The CHAIRMAN extended a welcome to the Association, and said that in the matter of their gas-works he thought they had no reason to be ashamed; while in their Manager they had a man who was thoroughly interested in his work, and who did the best he could for the Corporation, to whom he was immediately responsible, and for the community whom he served in a wider sense. To those who had been to the gas-works, he probably did not require to say that possibly the system of stoking they had in operation was not quite in keeping with the rest of the works; but, on the advice of their Manager, they had been considering the desirability of adopting mechanical stoking. The desire of the Committee was that they might be able to recommend the Council to adopt machinery which would be economical, and at the same time, so far as the workers were concerned, more humane than the present system.

The PRESIDENT, having briefly thanked the Corporation of Perth for their kindness and hospitality,

The HON. SECRETARY (Mr. J. Dickson, of Kelty), on being called upon by the Chairman, added his thanks. He said that perhaps the Corporation of Perth were in about as pleasant a position, as regarded capital expenditure, as any town in Scotland. It was wonderful to see gas produced in Perth, taking the capital charges into account, and sold at 2s. 11d. per 1000 cubic feet. This meant that Mr. M'Lusky was taking the most he could out of the existing plant; and he had no doubt that when the extensions which were in contemplation were carried through, there would be cheaper gas in Perth.

Mr. E. B. Barnard, the Chairman of the Metropolitan Water Board, has been elected Chairman of the Lea Conservancy Board.

"Commercial Peat: Its Uses and Possibilities," is the title of a work by Mr. F. T. Gissing which has lately been published by Messrs. Charles Griffin and Co., Limited, as one of their series of scientific text-books. Mr. Gissing is joint author with the late Mr. P. R. Björling of "Peat: Its Use and Manufacture," which was well received by engineers and others. The present volume is designed as a companion to it, and deals with the question from a commercial point of view. The price of the book, of which a fuller notice will be given in a later issue, is 6s. net.

EFFECT OF SEA WATER ON CONCRETE.

On the occasion of the meeting in Copenhagen last year of the International Commission on Reinforced Concrete, two pamphlets were distributed dealing with the problem of the influence of sea water on cement and concrete. One was a report by Herr A. Poulsen and the other one issued by the Association of German Portland Cement Manufacturers. Summaries of the pamphlets appear in the current number of "Concrete and Constructional Engineering," from which we take the following particulars.

The changes undergone by cement mortars and concretes in contact with sea water have been investigated by many workers (prominent among whom is Le Chatelier), without leading to entirely conclusive results. Systematic tests of this kind necessitate considerable organization, as it is not sufficient to immerse laboratory specimens in vessels containing sea water, but the actual conditions prevailing in coast constructions—rise and fall of tides, exposure to air and frosts, variations in temperature, &c.—must also be taken into account. The results of two very extensive and systematic series of tests have just been published almost simultaneously, with the effect of adding materially to the stock of knowledge on the subject. The first were due to the initiative of the Scandinavian Portland Cement Manufacturers, with the co-operation of the harbour authorities; the second form a part of the extensive researches in connection with cement undertaken by the great German testing-station at Gross-Lichterfeld, near Berlin; and the report, drawn up by Professor Gary and Herr Schneider, is published in the Bulletin of the institution. Both series of tests were conducted over a period of ten years; and, so far as it is possible to draw definite conclusions, the following may be said to be the principal results of the experiments:—

1.—Good portland cements, such as are now on the European market, are very resistant to the action of sea water.

2.—In a dense mortar, the chemical action is confined to an outer layer of small depth; further action being checked by the slowness of diffusion. A porous mortar, by admitting salt water to the interior, is apt to crack by expansion, owing to chemical change.

3.—The main agency in the destruction of mortar and concrete in marine embankments, harbour works, groynes, &c., is not chemical action, but the alternations of saturation, drying in the sun, freezing, &c., due to the alternate exposure and covering by the rise and fall of the tide. Destruction takes place sometimes by cracking, sometimes by scaling—the latter effect produced especially by frost.

4.—The denser the mortar the better (1 cement : 3 sand is too poor). An admixture of fine sand with the ordinary sand increases the closeness of the mixture. A well-graded aggregate would be advantageous for the same reason.

5.—The addition of finely-ground silica or trass to the cement before mixing is possibly advantageous in the case of weaker mortars. It is doubtful whether anything is gained by adding trass to the richer mortars.

6.—Hydraulic lime mixed with trass, &c., while of some value, where a cheap material is required, in the mild climate and absence of tide of the Mediterranean, is incapable of withstanding the conditions of coast work in northern latitudes.

7.—The destructive action of the sea being mainly physical and mechanical, and not chemical, tests by mere immersion in still sea water are of very little value in determining the behaviour of concrete in marine engineering works. A mixture which disintegrates under this test is certainly useless, but a mixture which passes the test may disintegrate possibly under the more stringent conditions of practical use.

8.—As long a period as is practicable should be allowed for the hardening of concrete blocks before placing in the sea. The German recommendation of one year in moist sand before setting in place is probably impracticable in most places, but should be approached as nearly as possible.

9.—The behaviour of test specimens for the first twelve months is very irregular, and definite conclusions can only be drawn from the results of long-period tests.

Death of a Well-Known Patent Expert.—The death occurred on the 6th inst., at the age of 64, of Sir William Lloyd Wise, the well-known authority on patent laws. He was the founder and first President of the Institute of Patent Agents, and had held the position for seven years.

Recent Wills.—Mr. E. H. Cardwell, one of the Directors of the South Metropolitan Gas Company, whose death was recorded in the "JOURNAL" for the 7th ult., left estate valued at £112,700 gross, with £105,396 net personalty. Mr. F. A. Gamble, formerly Secretary of the Gainsborough Gas Company, left property of the value of £5800. Dr. Ludwig Mond, whose death on the 11th ult. was noticed in the "JOURNAL" at the time, left estate which has been sworn for probate "at not less than £1,000,000."

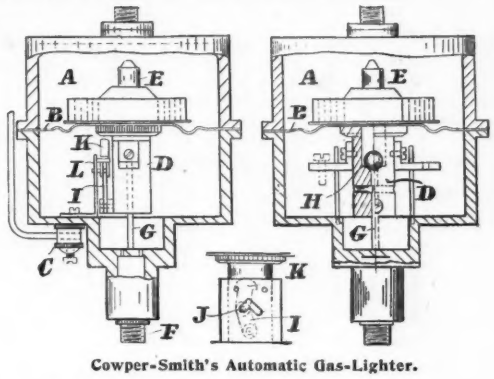
REGISTER OF PATENTS.

Automatic Gas Lighting.

COWPER-SMITH, M. G., of Tunbridge Wells.

No. 19,722; Sept. 19, 1908.

This mechanism designed for automatic gas lighting is one in which increase of pressure acts on a diaphragm, whose rise and fall causes the gas-conduit to be closed or opened; lever mechanism in conjunction with non-return gates or notches being provided for temporarily retaining the diaphragm in its respective positions.



Cowper-Smith's Automatic Gas-Lighter.

The chamber A is divided by the diaphragm B into two parts. At C is a bye-pass of common form. Attached to the diaphragm is a cylinder or tube D of sufficient weight to resist normal pressures. On the upper part the cylinder is fitted with an arrangement E that will permit gas to pass into the upper part of the chamber when the supply is open. F is the gas-inlet, which leads to the interior of D; and in it is a rod G on which rests the ball H when the cylinder is in one position; and when the cylinder is raised, the ball closes the aperture below. On the outside of the cylinder is a rod or bar I, pivoted on the cylinder so that it may swing from right to left. L is a guide-plate and support for it. At J, there is hinged to the bar a tumbler K, the pin of which is free to move in an angular slot in the plate L adjacent to the bar. Two pins are provided on the plate L, with which recessed parts on the tumbler engage.

When the parts are in the position shown in the separate detail, normal pressure obtains under the diaphragm; the ball H resting on the aperture below it, because the cylinder D is in position with its pin in the short limb of the slot. If the pressue be now increrased, the diaphragm, and with it the cylinder D, will rise until the pin is in the highest part of the angular slot. The tumbler K will now fall over towards the right, and will thus present the pin to the long limb of the angular slot; and if, now, the pressure returns to the normal, the cylinder is permitted, by reason of the length of the slot, to travel down farther. This second downward travel is so calculated that it brings the outlet at a level somewhat lower than the upper end of the rod G. It turns the ball H aside, or raises it so that a clear passage is made from F, through the cylinder D, to the upper part of the arrangement at E, and thence to the outlet, upon which is fixed, or with which is connected, the burner. If pressure under the diaphragm is again increased, the operation is reversed; and the cylinder and parts connected with it return to the original position, and the supply is cut off.

Controlling and Directing the Passage of Gas.

MILBOURNE, R. J., of Muxton, near Newport, Salop.

No. 28,207; Dec. 28, 1908.

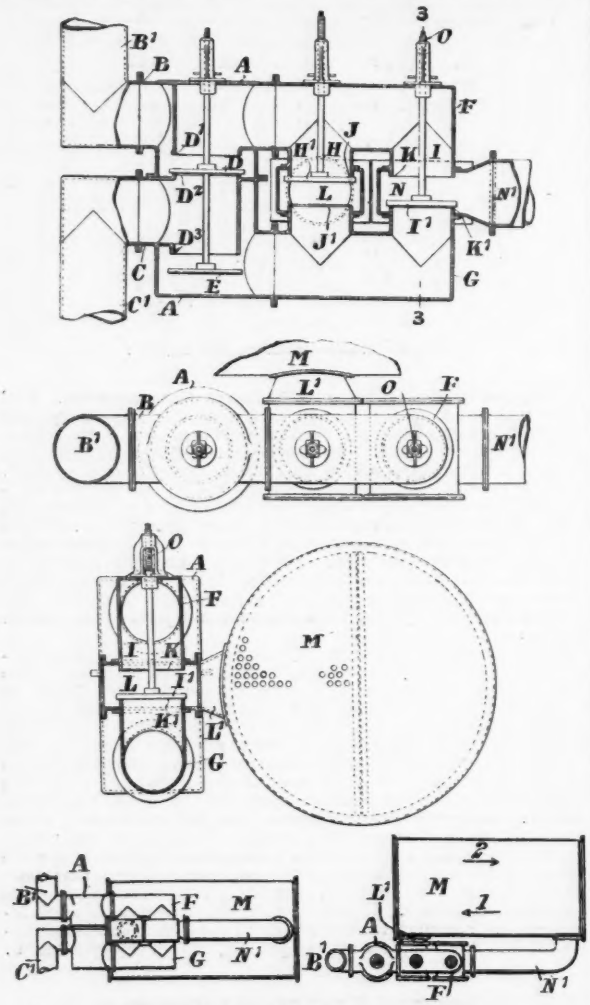
This apparatus is specially intended for use in directing and controlling or reversing the flow of gas into and out of condensers, scrubbers, &c., and for bye-passing such vessels when required. The patentee proposes to combine with a valvular device of the kind described in patent No. 16,911 of 1906 (wherein a chamber is employed provided with inlet and outlet pipes or connections and containing two valves adapted to be simultaneously controlled by one spindle) two other chambers which are superposed and respectively connected to the upper and lower parts of the principal chamber. These superposed chambers have two communicating passages arranged between them—each having in it a valve for controlling the flow of gas through it, and being adapted for connection to the vessel through which the gas is to be caused to flow.

A (p. 182) is a valvular device (according to the 1906 patent) provided with connections B C, to which the inlet and outlet pipes B^1 C^1 are attached, and with the valves D E. The former co-operates with the two seats D^1 D^2, and the latter with the seat D^3 in the manner described in the earlier specification. F G are the two superposed chambers, which, according to the present invention, are combined with the valvular device A. The upper chamber F is in communication with the valvular device above the valve D, and the lower chamber G with the valvular device below the valve. H I are two passages which establish communication between the chamber F and the chamber G; and H^1 I^1 are the valves arranged in the passages.

The valve H^1 operates in conjunction with the seats J J^1, and the valve I in conjunction with the seats K K^1; the space L between the valve seats J J^1 is adapted to be united by a connection L^1 to one end of a condenser M, as indicated in the small detail drawing, and the space N between the valve seats K K^1 communicates with the other end of the condenser through the connection N^1. The spindles of the

valves extend through the wall of the apparatus, and are screw-threaded at O, so that they may be operated by a wheel for altering their position.

Assuming it is desired to pass gas from the main B^1 through the condenser and thence into the main C^1, the valve D is upon the seat D^2 and the valve E away from its seat D^3; while the valve H^1 is upon the seat J and the valve I upon the seat K^1. The gas then flows from the main B^1 through the opening and the seat D^1 into the upper chamber F; thence through the passage I and the connection N^1 to the condenser, through which the gas flows in the direction of the arrow 1 in the detail drawing. The gas flows from the condenser through the connection L^1 and the passage H into the lower chamber G, and thence through the lower part of the chamber A, past the valve C, into the pipe C^1. If it is desired to cause the gas to flow through the condenser in the reverse



Milbourne's Valve-Controlling Arrangement.

direction, the valve H^1 is moved away from the seat J on to the seat J^1, and the valve I^1 away from the seat K^1 on to the seat K. The gas then flows through the upper part of the chamber A into the upper chamber F; thence through the connection L^1 into the condenser, through which it passes in the direction of the arrow 2; and thence through the connection N^1 and the passage I into the lower chamber G, and thence into the pipe C^1. If it is desired to bye-pass the condenser, it is only necessary to alter the position of the valves D E in order to bring the valve D on to the seat D^1, and the valve E on to the seat D^3. The gas then flows into the upper part of the chamber A, and then passes, through the opening in the seat D^2, directly to the pipe C^1; the valves D and E preventing the gas from flowing into either of the chambers F and G, which are in connection with the condenser.

Gas Lighting Appliances.

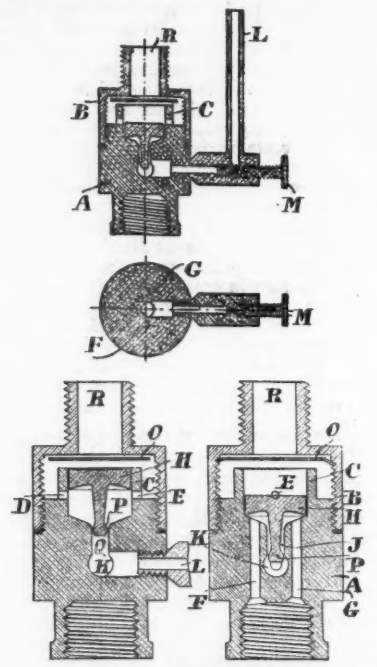
BOND, C. F., of Old Kent Road, S.E.

No. 1398; Jan. 20, 1909.

This invention refers to lighting appliances wherein there is normally a minimum supply of gas sufficient to constantly maintain a pilot flame, and wherein, on the pressure being raised (by turning on a cock situated possibly at some distance from the burner), the burner itself is supplied and is lighted by the pilot flame, the supply of gas to which is simultaneously reduced.

Appliances acting on this principle have already been designed, the patentee remarks, and have comprised a piston which is lifted when the pressure of the gas is increased so as to allow the gas to get to the burner; some part of the piston being arranged at the same time to cut off altogether the supply of gas to the pilot flame. In some cases there have been two passages for the gas to the pilot flame, one only of which has been closed by the rise of the piston.

The present invention "is intended to provide an improved piston apparatus for the same end." It comprises a form of piston which is not dependent upon the closeness of its fit within its cylinder to cut off the supply of gas to the burner, and which is furnished with a depending portion or tail attached to it, to partly throttle the passage to the pilot light when it rises, and thus reduce the pilot light to a minimum when the burner is alight. To provide an efficient cut-off with a loose piston, the latter is furnished with a seat within the cylinder, upon which it rests when the pressure of gas is only sufficient to supply the pilot flame. By forming at the tail part of the piston a spherical or widened portion which is raised into the passage to the pilot light with the rising of the piston, the passage is partially closed. The use of two passages of the pilot light is thus obviated.



Bond's Gas Lighting Appliances.

To the service pipe under the burner is fixed a cylinder made in two halves A and B screwed together. The lower or gas inlet end of the cylinder is solid, with a circular projection C with two gas-ports D E in it. Inside this portion, two gas ports or passages F G are formed, admitting gas to the underside of a piston H, which fits loosely within the part C—the necessary gas-tight contact being between the underside of the piston and a seating formed in the part A. When the pressure is low, the piston remains upon its seat; the weight of the piston being designed to prevent its moving upwards. The gas then passes down through the annulus J into the bye-pass chamber K, and on to the pilot light through the tube L; the size of light being regulated by the screw M.

When the pressure is increased by turning on the burner supply cock, the action is as follows: The piston is lifted upwards and the gas passes through the ports D E and round the diaphragm baffle O and then on to the burner by the gas outlet R. On the end of the piston axis an enlarged spherical part P is formed, which, in passing upwards through the central passage Q, reduces the amount of gas going forward through L. By this means, while the burner is alight the size of the pilot flame is reduced to a minimum.

On the pressure of gas being reduced by turning off the burner supply cock, the reverse action takes place. The burner is extinguished, and the pilot light is increased in size slightly.

Electrical Ignition Devices for Gas-Lamps.

KEITH, J. & G., of Farringdon Avenue, E.C.

No. 7827; April 1, 1909.

This invention relates to ignition devices for gas-lamps of the kind in which an electric current is passed through a filament of platinum, nickel, or the like to heat it, so as, by the action of the hot platinum on the gas or of the gas on the platinum, to produce combustion of the gaseous mixture.

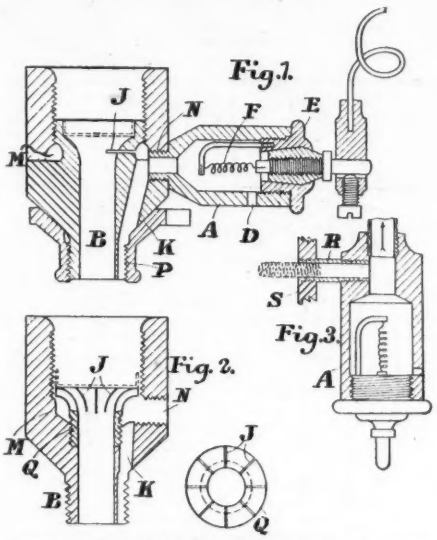
In such apparatus, the patentees point out, it has been found advantageous to locate the platinum in a small chamber disposed alongside of, and communicating with, the burner, and so arranged that a small portion of the explosive mixture is allowed to pass slowly through it, so that when the platinum is heated to the temperature at which the mixture explodes, an explosion is produced of the quiescent mixture in the chamber, whereby a flame is shot into the main flow of mixed gas and air issuing from the burner-nozzle, and the mixture is effectually ignited. But, even with such an arrangement, there is risk of the burner lighting-back. Accordingly, they propose that the communicating passage between the main supply to the burner and the chamber should be constituted by a fine saw-cut or a slit—a separate outlet being led from the explosion chamber to the outside of the burner-nozzle.

Figs. 1 and 2 (p. 183) are vertical sections of the devices as applied to an inverted incandescent gas-burner. Fig. 3 shows the device as applied to an upright incandescent burner.

In fig. 1, the chamber may be in the form of a small box A alongside

the burner-nozzle B; an orifice D being bored in the bottom of the box, so as to facilitate the entrance of the mixture into the chamber and to permit the burnt products to escape after an explosion of the mixture has taken place. Into the end of the box is fitted a plug E, carrying a filament F with connections to a source of current—this arrangement being that usually employed.

In order to prevent the flame of the explosion in A from passing to the main body of mixture in the burner-nozzle, it is now proposed to feed the explosion chamber through fine saw-cuts or slits, such as J, and to ignite the mixture at the burner-nozzle B by means of an additional outlet K, leading to the outside of the nozzle but inside the mantle.



Keith's Electrical Ignition Devices for Gas-Burners.

The gaseous mixture impinges on the trumpet-mouthed entrance to the constricted part of the nozzle B (fig. 1) and a certain quantity passes through the saw-slit J to the annular groove M, and thus, through the port K and the groove P, to the outside of the nozzle. The portion of the mixture which passes through the slit enters the explosion chamber or box A; and when this is ignited, a flame is shot down the port K and the groove P to the inside of the mantle—thus igniting the mixture at the outlet end of the nozzle. The fine saw-slot J, although sufficient to allow the mixture to pass into the explosion chamber and the port and groove, will not permit the passage of flame to the main body of the mixture which passes downwards through the nozzle. Thus, no matter how hot the nozzle may be, there is no lighting back.

The construction shown in fig. 2 is similar, except that the nozzle B proper is formed in one piece, and has a bush Q secured to it, so as to form an annular groove M leading to the port K and to the tapped orifice N, into which the explosion chamber is screwed. A number of vertical saw-slits J are formed in the upper portion of the bush, so as to give ample feeding area to the groove.

In fig. 3, the explosion chamber A has connected to it a tube R, which supplies the mixture to the explosion chamber and which is secured to the wall S of the burner body or the nozzle; the tube being provided at its inlet end with a gauze protection T, or a tube closed at one end and having fine saw-slits may be provided. When the mixture is exploded in the chamber A, the flame passes, by way of a tube U, to the mantle.

Manufacture of Ammonium Sulphate from Gases.

GEWERKSCHAFT DER STEINKOHLENZECHE "MONT-CENIS," of Sodingen, Germany.

No. 11,442; May 14, 1909. Date claimed under International Convention, May 15, 1908.

In the course of their specification, the patentees remark: The production of sulphate of ammonia from plant for generating heating or illuminating gas from coal has heretofore been generally practised as follows: The ammonia contained in the gases is washed out with water, and the ammonia water so obtained is distilled in column stills. Attempts have been made to withdraw the ammonia directly from the gases by means of sulphuric acid; and in these experiments, the following facts have been discovered: If the gases containing ammonia be conducted into concentrated sulphuric acid, solid salt (ammonia sulphate) is obtained, yet there is also a strong action of the sulphuric acid on the gas itself, which gives rise to troublesome separation of tar. If, however, the absorption liquid only contains a small quantity of free acid, no separation of tar takes place, but at the same time there is no separation of salt; so that the liquid obtained has to be evaporated in order to get the salt—involving heavy expense. A process has also been suggested in which an absorption liquid containing a comparatively small quantity of concentrated sulphuric acid is employed; but in order to effect the separation of the salt—that is to say, in order to prevent condensation of the water vapour contained in the gas—the gas, after separation of the vapours of tar and water, is again specially superheated before it passes into the absorption liquid. This superheating of the gas was intended not only to prevent condensation of the water vapour in the gas, but also to ensure that no further dilution of the absorption liquid should take place by condensation of the water in the simultaneous introduction of ammonia saturated with water vapour from the stills which treat the ammonia water that forms in the cooling of the gas.

Practical work with such a process has shown that, on the one hand, the superheating of the gas prior to its introduction into the absorption liquid necessitates special complicated apparatus, and that, on the other hand, the superheating does not suffice for preventing the condensation of the water vapour which simultaneously comes from the ammonia stills. There rather takes place with the process either a progressive dilution of the absorption liquid, so that no solid salts separate out, or the superheating must be carried to such a degree that decomposition of the ammonium sulphate (which is noticeable even at 90° C.) takes place.

According to the present invention, these disadvantages are said to be obviated in that, on the one hand, the troublesome superheating of the gas is dispensed with, and, on the other hand, separation of solid salt is caused to take place continuously; and although only a single absorption vessel is used, both the ammonia is withdrawn from the distillation gases and also the ammonia is fixed which is obtained in the column still from the ammonia water that forms in the cooling of the distillation gas when the tar and water vapour are removed.

The distillation gas is cooled to a temperature of from 15° to 20° C., and thus freed from tar. At the same time, a part of the ammonia contained in the gas (about one-fifth of it) is thrown down with the water of condensation. The cooled gas containing ammonia is now conducted without further heating into a solution of sulphate of ammonia, preferably of a strength of 29° to 35° Beaumé, which contains up to 5 per cent. of free sulphuric acid. Into this solution is simultaneously conducted the gas obtained by treating in the column still the ammonia contained in the water of condensation, but in a concentrated form.

By this means, the formation of solid salt in the absorption liquid is obtained, without any further dilution of the liquid taking place. In the supply of the concentrated ammonia gas to the absorption liquid, the heat resulting from the chemical action of ammonia on sulphuric acid is sufficient to prevent condensation of the water-vapour, both from the distillation gas and also from the column-still gas, without any special arrangement being required for superheating the mixture of water-vapour and ammonia introduced.

The production of the concentrated ammonia gas from the waste gases of the column still preferably takes place in the usual manner—that is to say, these gases pass through a cooler or condenser, and are thus cooled down to 40° or 60° C. By this means, not only is concentration of the ammonia gas obtained, but separation of water-vapour is effected; so that the latter no longer has a detrimental effect on the concentration of the absorption liquid. In this way, solid salt free from tar is continuously formed in the absorption liquid; the ammonia washer-scrubbers are dispensed with in the treatment of the gas according to this improved process; the labour in the ammonia-works is reduced by about 75 per cent.; and the amount of waste water is reduced by 75 per cent.

Manufacture of Incandescence Bodies.

HADDAN, H. J; a communication from the BRUNO-PATENTE-VERWERTUNGS, G.m.b.H., of Berlin.

No. 12,467; May 26, 1909.

According to the generally accepted theory of incandescent gas lighting, the patentees remark, the high efficiency of the method depends upon a co-action of oxide of thorium and oxide of cerium—the oxide of cerium performing the function of oxygen bearer. The most favourable effect is obtained if there are about 99 parts of oxide of thorium and 1 part of oxide of cerium. It has been observed that, in course of time, the bodies suffer loss of efficiency, though no change in the proportions of oxide of thorium and the oxide of cerium can be analytically ascertained. The reason of this peculiar observation is as follows: In the case of the ordinary incandescence mantles manufactured by impregnating the fabric in a mixture of the nitrates of thorium and cerium, with subsequent denitration by means of a gas-flame, the resultant mixture of oxides of thorium and cerium are in a more or less spongy state—due to the swelling of the oxides. In the first stages of use, the spongy state of the oxides is very favourable, inasmuch as it facilitates the exchange of oxygen, more particularly in the case of the cerium oxide. In the course of use, however, the spongy oxides fuse more and more together, so that the oxide of cerium becomes more and more enveloped by the thorium oxide, and is consequently prevented from performing its function as bearer of oxygen. If the active service of the oxide of cerium can be maintained at the same area, an incandescence body of constant illuminating efficiency must necessarily result. It is, therefore, necessary to deposit the cerium oxide in a spongy state on a skeleton structure of pure thorium oxide. The durability and efficiency are increased if the thorium oxide is not spongy but fused together.

The object of the present invention is to produce incandescence bodies of this kind; but the invention is not restricted to the use of salts of thorium and cerium. For this purpose, the fabric is first immersed in a solution of thorium nitrate or equivalent salt alone. The nitrate is then converted into oxide (hydrate or a basic compound salt), either by the Blasco de Lery process of treatment with ammonia or other alkali, or by the use of other suitable agents. After the removal of the excess of this solution from the filament, the latter is immersed in a solution of the second illuminating agent—preferably nitrate of cerium, which may be neutral or slightly alkaline. After the second immersion, the fabric is dried and treated in the usual manner with a gas-flame. The action of the flame results "in the production of a compact, strong skeleton structure of thorium oxide, with a coating of spongy cerium oxide. The two oxides do not mingle in course of use, and the cerium oxide retains its full activity."

No general claim is made to separately and consecutively applying thorium nitrate and cerium nitrate to the fabric, or to the conversion of the thorium nitrate by chemical means. It has, for example, been proposed to impregnate the fabric first with a thorium salt and then with a cerium salt, and to separately precipitate each of the salts by means of an organic base. According to the present invention, the cerium or equivalent salt is not chemically treated, but is converted by means of a flame into spongy oxide, deposited on a dense, compact structure of thorium oxide.

It will be seen, the inventors state in concluding their specification,

that the process also differs from the known process of saturating the fabric with thorium nitrate, then burning it, immersing the ash skeleton in a solution of cerium nitrate, and finally again exposing the structure to a gas-flame. This previously known process gives results inferior to those obtained by using mixed solutions of salts, owing to the fact that the spongy thorium oxide absorbs the second solution; so that the cerium oxide is too much enveloped to properly perform its function. Moreover, the structure of thorium oxide is very liable to break during the second immersion; and it is difficult to accurately proportion the oxides. The result by the improved process is not obtainable by treatment of the filament with a solution of cerium salt and peroxide of hydrogen, after its immersion in thorium nitrate. The reaction of thorium nitrate and hydric peroxide is not sufficiently rapid to prevent intermingling of the thorium and cerium salts.

Liquid Meters.

CHECINSKI, A. F., of Paris.

No. 13,673; June 10, 1909. Date claimed under International Convention, June 12, 1908.

This invention relates to "turbine meters," having a turbine wheel in the form of a hollow body submerged in the water to be measured; and the object of the invention is "to increase to a certain extent the sensitiveness of the apparatus." To this effect the turbine wheel is of an ovoid shape; the upper half being provided with the usual blades or vanes. The outlets for the liquid are placed near the foot of the vanes; and the second or lower part of the wheel is immersed in a chamber beneath the outlets, so that no eddies arise in the chamber; "whereby the sensitiveness of the apparatus may be increased."

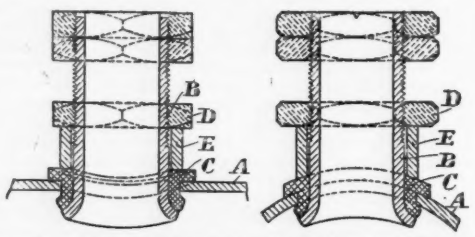
The advantages claimed for the meter are the following: Owing to the hollow movable part and to the inclination of the vanes of that part to the vertical, the meter is exceedingly sensitive, and "can measure even the smallest volumes of liquid without loss of accuracy." It is not necessary to have pressure in the supply conduit, since the weight of the liquid alone is sufficient to cause the movable part to rotate. The meter may also be arranged as a bye-pass to the main conduit. The contraction towards the top forms passages of gradually increasing cross section towards the outlet, which promotes the flow of liquid through the meter because it has a tendency to flow down to the place of greatest section. The vanes have such a form on the arrival side of the liquid as to allow the liquid to act upon them by its weight, and thereby cause the rotation of the hollow body.

Fitting Branch Service Connections to Main Pipes.

STEWARTS AND LLOYDS, LIMITED, of Coatbridge, and BALLANTYNE, R., of Glasgow.

No. 21,358; Sept. 18, 1909.

The inventors' object is "to simplify the operation of taking a branch off a main and to simplify the means employed for this purpose."



Stewarts and Lloyds and Ballantyne's Service-Pipe Connection.

Sectional views (at right angles to one another) are given, showing the main pipe fitted with a nipple for attachment to a branch connection, with the devices for securing the nipple in place.

An orifice is drilled in the main A, into which is inserted the nipple B—tapered or flared at the end which enters the main and screw-threaded over part of its length. Over the nipple is passed a washer C, comprising a tubular portion which projects into the main and an annular flange portion which bears on its outer surface. Between the flange portion and a nut D, in screw-threaded engagement with the nipple, is interposed a distance-piece E. The nipple is drawn outwards by rotating the nut; and, in consequence of the pressure of the thickened end of the nipple on the washer, the tubular portion of it is caused to assume the form shown, and being pressed against the inner surface of the main provides a tight joint between the nipple and the main. Two jam nuts at the outer end of the nipple afford means for holding the nipple in position while the nut is being tightened up.

Gas-Main Stoppers.

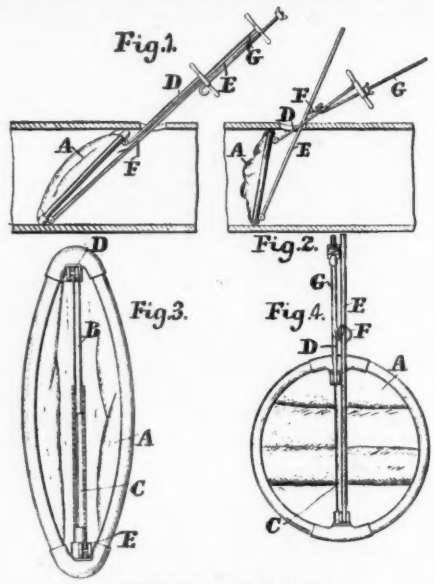
GOODMAN, P., of New York City.

No. 24,480; Oct. 25, 1909.

These gas-main stoppers embody a collapsible spring frame having a flexible diaphragm, which is expanded by exerting pressure at diametrically opposite points, and having handle-bars pivotally connected at or near these points to control the position of the diaphragm in the main. The invention contemplates means to simultaneously force one of the handle-bars inwardly and draw the other handle-bar outwardly to lock the stopper crosswise of the main.

Fig. 1 is a central longitudinal section through a gas-main, showing a stopper in position preparatory to expanding it. Fig. 2 shows the stopper fully expanded and locked in position. Fig. 3 is an inner face view of the stopper, partly in central vertical section. Fig. 4 shows the stopper fully expanded.

The stopper is a collapsible spring frame covered by a yielding packing and having a flexible diaphragm A stretched across it in circular form by exerting pressure on the frame at diametrically opposite points. At these points the frame is provided with pivotally connected telescoping members B C, bridging the diaphragm, and pivotally connected handle-bars D E, each provided with a hand-grip. A ring F is swiveled intermediate the length of one of the handle-bars; and a hook G is adapted to be engaged with, and disengaged from, the ring. It has a threaded shank passing through the hand-grip of the other handle-bar, where it is provided with a nut to draw the hook outwardly.



Goodman's Gas-Main Stopper.

In use, the body of the stopper, fully collapsed, is passed through an opening in the main and placed at an inclination at that side of the main from which the gas is flowing. The handle-bar having the ring, and which is connected to the bottom of the stopper, is then drawn outwardly, to position the stopper crosswise of the main. The hook is then engaged in the ring, and on tightening the nut on the shank of the hook, the handle-bar at the top is forced inwardly, and the inwardly-extending handle-bar is pulled outwardly—thus tending to turn the body of the stopper further crosswise of the main, and locking it in place and effectually stopping the flow of gas.

APPLICATIONS FOR LETTERS PATENT.

29.—MACPHERSON, A., "Generation of petrol gas." Jan. 1.
63.—SCHORR, P., "Igniting-apparatus." Jan. 1.
76.—AUTOLOCK SAFETY LOCK AND BOLT COMPANY, LTD., and FAVERO, M., "Cocks or taps." Jan. 1.
92.—HOLT., J., "Joints on pipes." Jan. 3.
103.—LANGFORD, P. N., and SHILTON, W. A., "Fastenings for doors of retorts and mouthpieces." Jan. 3.
164.—LYNDE, F. C., "Increasing the economy in the heating of surfaces and utensils by gas-flames." Jan. 4.
185.—SMITH, H. P., "Pipe-joints." Jan. 4.
214.—CHANDLER, S. B., "Purification of gas." Jan. 4.
216.—PEARCE, R. F., "Collection of dust and other matter suspended in gas." Jan. 4.
269.—HARSANT, H., "Petrol gas apparatus." Jan. 5.
286.—SOCIÉTÉ AUBERT FRÈRES, "Electrically kindling gas-burners." Jan. 5.
316.—TULLY, C. B., "Destructive distillation of coal." Jan. 5.
327.—DARRAH, H. M., and MARTIN, J., "Geysers." Jan. 6.
342.—MERRICK, S. G., "Gas-purifiers." Jan. 6.
353.—M'LAREN, E., "Inverted gas-lamps." Jan. 6.
396.—LAMKIN, A. E., and HUNTER, L., "Incandescence burners and mantles." Jan. 6.
397.—LAMKIN, A. E., and HUNTER, L., "Ignition of combustible gases." Jan. 6.
398.—LAMKIN, A. E., and HUNTER, L., "Controlling the flow of gas." Jan. 6.
402.—LAMKIN, A. E., and HUNTER, L., "Switches for gas." Jan. 6.
423.—BRAY, A., "Acetylene burners." Jan. 7.
434.—JANSEN, F., "Gas-stoves." Jan. 7.
437.—SCOTT-SNELL, E., "Producing gas from petrol." Jan. 7.
441.—NEVEU, E. DE, "Incandescent gas-burner." Jan. 7.
442.—SAUVAGEOT, S. J., "Obtaining mineral grease and retort carbon from coal-tar residues." Jan. 7.
491.—LYNDE, F. C., "Increasing the economy in heating of surfaces and utensils by gas-flames." Jan. 8.
493-4.—YATES, H. J., "Gas-fires." Jan. 8.
526.—WOLF, O., BAMBURY, N. F., and BERNARDY, E., "Inverted gas-lamps." Jan. 8.
534.—METAL JOINTING COMPANY, LTD., and HARDEN, T., "Jointing of pipes." Jan. 8.
536.—METAL JOINTING COMPANY, LTD., and HARDEN, T., "Jointing of pipes." Jan. 8.
540.—SHELDON, J. T., "Stop-valves." Jan. 8.
541.—WILHELM, C., "Opening and shutting the gas-way of burners by means of electricity." Jan. 8.
556.—ROBIN, J. I., and WHITE, C., "Mantles." Jan. 8.

CORRESPONDENCE.

[We are not responsible for opinions expressed by Correspondents.]

Air-Gas Lighting.

SIR,—I have just read under this heading in your issue of Dec. 28, p. 886, the article which presumes to g ve an exposition of "Air-Gas Lighting: Its Advantages, Some of Its Defects, and How to Remedy Them"—being a tissue of imaginary vapourings entirely belying the heading which the author has placed over it, and proving that he has not yet passed through the novitiate stage of air-gas lighting experience, and is thus quite unfitted to venture on an exposition as to the position to which petrol air-gas lighting has attained.

Many years ago, such a sentence as "very considerable progress has been made in the way of producing a satisfactory light from this agent" might have been written. For years past, no obstacle whatever to the attainment of most satisfactory petrol air-gas lighting has existed. The readers of the "JOURNAL," if they have given this article a glance, must have perceived the many inconsistencies and contradictions the author makes in his rambling statements. At any rate, every reader who occasionally consumes coal gas *plus* atmospheric air within mantles would immediately discern something very different as the proper explanations for his remarks regarding ·680 (or of any other specific gravity) petrol, and would become particularly mystified regarding that "other objectionable matter."

The petrol air-gas plant with which I have been associated ever since it was first constructed nearly three years ago (and capable of generating 50,000 to 60,000 cubic feet of gas per day) has not only required no re-adjustment, but has in the most perfect manner generated petrol gas to fill ordinary gas-works holders, from which, during even the severest frosty weather experienced in the past thirty years, has been supplied uninterruptedly the gas to consumers through, not the quoted wonderful "5000 feet," but through 5 miles of road mains and services, besides probably other 5 miles of house-supply pipes, and this without any condensation whatever in street-mains, gas-meters, or the consumers' pipes or fittings. Every consumer is satisfied with the quality and wholesomeness of the gas, the permanent quality of which was verified by the fact that during such severe weather, as at all other times, those consumers farthest from the gas-works continually testified to the brilliance of their lights; mantles blackened by carbon never having occurred or been heard of. All this is because the turbine generator is a scientific and correctly designed and constructed apparatus for dealing with air and petrol by the fractionizing of both in small volumes; the units uniting within a central mixing-chamber before passing to the gasholders or to the consumers' fittings.

This statement completely annihilates the whole fabric of his story, with the author's mysterious "defects," and his as mysterious failure to show how to remedy them. It is noteworthy that he markedly omits to commit himself to an expression of opinion on the only other petrol air-gas generator omitted from his list of those which he has "damned with his faint praise."

109, *Hope Street, Glasgow, Jan.* 10, 1910. WILLIAM KEY.

Proposed Expenditure on Gas and Water-Works Next Session.—We regret that, by an error on the part of the correspondent who sent the particulars, the amounts in the table under the above heading which appeared last week (p. 111) as the proposed total expenditure at Abertillery, Exmouth, Fylde, and Pontypridd, were given as exclusive nstead of inclusive of the items specified.

Improved Retort-House Plant at the Preston Gas-Works.

The Directors of the Preston Gas Company have decided to instal a bench of fourteen Klönne regenerative settings of six retorts, 24 ft. by 16 ft., and 22 feet long, operated by the Fiddes-Aldridge simultaneous charger, with stage floors, mountings, and complete coal and coke handling plant. The contract for the charging machine has been placed with Messrs. Aldridge and Ranken, and that for the De Brouwer conveyor with Messrs. W. J. Jenkins and Co. The successful Contractors for the retort-bench, floors, mountings, and coal and coke handling plant are Messrs. Robert Dempster and Sons, Limited, of Elland. The whole of the work has to be carried out in accordance with plans and specifications prepared by, and under the supervision of, Mr. Samuel Tagg, the Engineer and Manager of the Company.

Maryport Water-Works.—A contract has been placed with Messrs. C. Bushby and Sons, in connection with these works. It comprises a 10-inch cast-iron gravitation main from the Papcastle reservoir to the new filter-beds at Hayborough, about 4½ miles in length, and a 7-inch cast-iron gravitation main from the new filters to the service reservoir at Hayborough, about 650 yards in length, with air-sluice and washout valves and chambers, &c. Three concrete filters at Hayborough have a combined sand area of 1410 square yards. The amount of the contract is £10,586; and the Engineer for the scheme is Mr. J. C. Boyd, of Carlisle.

New Joint-Stock Companies.—The Henstridge Gas Company, Limited, has been registered with a capital of £500, in £1 shares, to manufacture, sell, and supply light and fuel in the parish of Henstridge, in Somersetshire, or in any neighbouring parishes, and to carry on the business of a gas company in all its branches. The Illuminating Engineering Company, Limited, has been registered as a private company with a capital of £10,000, in £1 shares, to acquire the patent rights in an invention entitled "Improvements in apparatus for lighting and extinguishing gas," together with any improvements for new inventions in connection therewith, and the rights, foreign or colonial, which may be obtained by Messrs. C. Ingrey and J. Bartlett, and to enter into an agreement with them and Messrs. R. Gill and J. S. Pollock.

LEGAL INTELLIGENCE.

QUESTION OF LIABILITY FOR A GAS EXPLOSION.

HIGH COURT OF JUSTICE—KING'S BENCH DIVISION.

Thursday, Jan. 13.

(Before Mr. Justice PHILLIMORE, *and a Common Jury.)*

Stacey v. Gaslight and Coke Company, Metropolitan Water Board, and West-End Tailoring Company.

This was an action to recover damages in respect of personal injuries sustained through a gas explosion which occurred in the Fulham Road on April 21, 1908.

Mr. MOYSES and Mr. DUNBAR appeared for the plaintiff; Mr. ELDON BANKES, K.C., and Mr. A. B. SHAW, for the Metropolitan Water Board; Mr. DANCKWERTS, K.C., and Mr. A. NEILSON, for the Gaslight and Coke Company; and Mr. ROGERS (trading as the West-End Tailoring Company) appeared in person. Before the case was opened, it was agreed that Mr. Rogers should be dismissed from the action—he not asking for costs.

Mr. MOYSES said the plaintiff, Miss Stacey, was walking along the Fulham Road on April 21, 1908; and when opposite the shop of Mr. Rogers, there was a terrific explosion, shattering the plate-glass window, and severely injuring her. No one could attribute to the plaintiff contributory negligence—she was lawfully using the highway; and the difficulty in the case was to place liability on the right persons. As the explosion was due to the ignition of gas which had escaped from the Gas Company's main, probably they were the persons liable. But they denied liability, alleging that the explosion was primarily due to leakage from a pipe of the Metropolitan Water Board washing away the soil from underneath the gas-pipe. The Water Board denied liability on the ground that the leakage was not from their main, but from a service-pipe belonging to a customer on whom notice to repair had been served.

Plaintiff was called, and described the nature of the injuries that she had sustained.

Dr. *T. J. Chipperfield*, who attended her, said his charges amounted to £5 3s.

Answers to interrogatories by the two Companies were then put in and read, from which it appeared that both the gas and water pipes were fractured.

Friday, Jan. 14.

William Rogers (trading as the West-End Tailoring Company) said that, as soon as the explosion took place, he communicated with the Gas Company, who sent some of their men; and they discovered a leak in the supply-pipe. Witness saw a leak. It was in the service-pipe just under the kerb of the footway, at a distance of 5 feet from his shop front. The iron communication pipe was about 3 feet below the surface. The explosion was in the corner of the shop farthest away from the meter. He supposed the gas followed the water-pipe into the cellar. The explosion was inside, not outside in the street. There was a crack in the gas-pipe about an inch long. It was an old rusty crack, and looked as if it had been there for some years. There was also a slight leakage from the water-pipe which went either over or under the gas-pipe. This leak was about 4 or 5 inches away from the leak in the gas-pipe. The water-pipe came into the premises at the same level as the gas-pipe. He had occupied the premises for about two years, during which time no one had interfered with either the gas or the water pipe. No one was working in the shop; and all the burners were carefully turned off.

By his LORDSHIP: He did not know what caused the explosion. The basement was full of gas. He could not say if any one struck a light. The gas might have forced its way up through the pavement and been ignited by a match thrown down by a smoker. After the explosion, he was required by the Water Board to have the water-pipe repaired.

Cross-examined by Mr. NEILSON: The explosion took place in the front shop. The only portion of the pavement disturbed was that just outside the shop, which had been closed from Thursday night to Tuesday morning. There was no smell of gas when he left on Thursday; but there was on the Tuesday, and all the windows and doors were at once opened. A gas-stove in the back-kitchen was alight. The explosion was in the basement; and the window board was forced upwards. When the gas men arrived, they saw the flames coming out of the ground. There was a little water under the gas-main, but not sufficient to cause subsidence of the ground. He did not know that a truck-load of earth was used to fill up the hole.

Cross-examined by Mr. SHAW: When the gas-pipe was removed and cut in half, the part cut through was quite bright; while the part where the crack existed was dark and rusty. There was no crack in the water-main, but simply a slight leak.

By the JURY: The gas-meter was turned off prior to the explosion. There was no fire in the basement where the explosion occurred.

A. H. Griffen, of No. 792, Fulham Road, said he heard the explosion and saw the window fall out. He could not say whether the pavement was disturbed.

A. F. Piper, a builder, said he was present when the pipe was taken out. He could not say which pipe was uppermost.

Cross-examined by Mr. SHAW: The pipe looked as if it had been broken with a hammer, so as to get it out. There were about 3 inches of rust. There was no water in the hole. He was speaking of the day after the accident.

This was the plaintiff's case.

Mr. BANKES submitted that there was no evidence against the Water Board that the leakage from the water-pipe contributed to the accident. Whatever leakage there was, came from a pipe belonging to the owner of the premises; and there was no evidence that the presence of the leak had been brought to the knowledge of the Water Board.

Justice PHILLIMORE said he was of opinion that there was no evidence that the leakage from the water-pipe caused or contributed to the escape of gas, or that they were in default in not having repaired the pipe; and therefore judgment would be entered in their favour.

Mr. BANKES said he did not ask for costs as against the plaintiff; but he might at a later stage have to ask for them as against the Gas Company.

Mr. DANCKWERTS then submitted that there was no case to go to the Jury as against the Gaslight and Coke Company, as the action was simply based on negligence. In *Ogden v. Gaslight and Coke Company*, Mr. Justice Darling ruled that it was necessary for plaintiff to prove injury from gas which got out of the pipe through the negligence of the defendants; and that if defendants had nothing to do with its accumulation once it was out of the pipe, they were entitled to judgment. This being so, it was necessary for the plaintiff to prove that the gas got out of the pipe through the negligence of the Gas Company. Now, what were the facts? On the Thursday when the shop was closed, there was nothing wrong; but the explosion occurred inside the shop on the Tuesday, blowing up the floor. When the ground was opened, it was found that the pipe had fractured—caused no doubt by the ground having subsided through leakage from a water-pipe.

His LORDSHIP remarked that the evidence was rather the other way.

Mr. DANCKWERTS said, even assuming that was so, it was necessary to prove defendants negligent in not finding out the escape.

His LORDSHIP said the evidence went to show there was an old rusty crack from which there must have been a considerable escape of gas.

Mr. DANCKWERTS asked what evidence there was that the Gas Company could possibly have found out there was an escape of gas.

His LORDSHIP thought there was enough to call upon the defendants to ans wer the case which had been made.

Mr. DANCKWERTS observed that in *Price v. South Metropolitan Gas Company* Lord Russell ruled that, before a plaintiff could succeed, he must prove there had been negligence on the part of the defendants. In that case, there was an escape of gas into the open, whereas in the present instance it was on closed premises. As there was no negligence on the part of the defendants, he submitted that the plaintiff should be non-suited.

His LORDSHIP ruled that there was some evidence to go to the Jury.

Mr. DANCKWERTS then proceeded to address the Jury. He said everyone must be sorry that the plaintiff had been injured; but no one had a right to express his sorrow at the expense of someone else's pocket. If there had been anything wrong on the Thursday night, one would have thought that Rogers would have noticed it, because as gas could not come up through the concrete on which the wood pavement was laid, it would naturally follow the line of least resistance, which was underneath the pavement, and into the premises alongside. This was what, in fact, did happen; and one could not help thinking that the gas had not escaped until comparatively late in the holidays. When Rogers came to the shop on the Tuesday, he smelt gas; and in some way, no one knew how, the gas was ignited. But there was nothing to show that any blame rested on the Gas Company. When the gangers arrived, means were employed to let the gas out of the ground; and then the pipe was temporarily repaired. On the following day, it was found that there was a leakage from the water-pipe which crossed the gas-pipe at right angles, causing subsidence, with the result that the pipe, being unsupported, was cracked by a passing motor omnibus. The Gas Company could not be continually going about digging up their mains to see whether they were growing, like vegetables. What they did was to offer a reward to persons reporting an escape of gas. Before liability could be saddled on the Gas Company, the Jury must be satisfied that they were negligent in letting the gas out of the pipe. If people would have gas, someone must supply it; and companies could only up to a point guard against accidents. There was no question as to the amount of damages, as these had been agreed between the parties.

A. T. Robson, District Main Inspector, proved having taken measurements from which he made a sketch plan of the *locus in quo*; and this was produced and handed to the Jury.

J. T. Redgrave, a fitter, said he was sent on April 21 to Fulham Road, in consequence of a telephone message received. On arrival, he found the fireman in possession, and told him to keep the fire as low as possible until he could get a gang of men. Both meters were turned off. If the fire had been put out, the gas would have escaped into the house again, and might have caused another explosion. Rogers denied having struck a match. Witness said he must have done so, or the gas would not have exploded. When the flagstone was taken out near the kerb, there was a hole full of water, which was baled out. After the water was cleared away, one of the men stopped the leak by knocking-up the lead pipe.

J. J. Skinner, a ganger, said he went to the scene of the explosion, and found the gas burning under the facia of the shop. He lifted the pavement so as to let the gas escape into the air. Under the pavement there was a hole full of water; and the ground to a depth of 6 inches round the main was sloppy. The broken pipe was cut out, and a new one put in; the hole being filled up with a truck-load of earth. There was slight rust on the bottom of the pipe from resting on the wet ground; and the crack was round the pipe near the hole drilled for the service-pipe. Making this hole did not cause the crack. The crack was a new one. It would have been rusted all round if it had been an old one. There was a great deal of heavy traffic on the road, as it was the main thoroughfare to Putney. His view was that the ground having been washed away, the vibration on the top caused the main to drop, and it was thus fractured. The main was 2 ft. 3 in. below the surface of the road.

G. Marvyn, Divisional Main Inspector, deposed that the service-pipe in question was laid in March, 1899. Witness had had upwards of forty years' experience; and from his inspection of the pipe on the day it was cut, he could say that the lower portion was slightly discolored —caused by the water getting into it. He agreed with the evidence already given as to the cause of the fracture. A gas-main in good ground would last practically for ever. Forty years was not a long time for a gas-main to be buried. They had some which had been in the ground for seventy years. Notice was received of an escape in March, 1908; and it was found to come from one of the lead joints. This was at once put right.

Mr. *H. S. Reeson*, the Distributing Engineer of the Company, said he examined the pieces of pipe two or three days after the explosion, and found it in good condition. The fracture was a recent one. The Company supplied gas over an area of 62 square miles, having 2184 miles of pipes varying in diameter internally from 3 inches to 48 inches. In addition, there were some 2000 miles of wrought-iron service-pipes through which gas was supplied to the consumers. Notices were always received from electric lighting companies and borough authorities of any openings which they had to make in connection with their plant; and workmen from the Gas Company were always sent to examine the pipes.

Mr. *G. Bird*, M.Inst.M.E., said he examined the pipe in question some three months ago, and found it to be a good one.

Cross-examined: Drilling the hole for the service-pipe, if properly done, would not tend to cause a fracture.

Counsel having addressed the Jury, his Lordship summed up; and, after some consultation, the verdict returned was for the defendant Company.

CLAIM ARISING OUT OF A TAR-PAINTED ROAD.

As was briefly stated in last week's "JOURNAL," judgment was delivered at the Ashford (Kent) County Court on Monday, the 10th inst., in the case of *Ellen and Sons v. Kent County Council*. It was a claim by the plaintiffs, who are farmers at Charing, for £26 16s. 6d. damages in respect of the loss of a cow, alleged to have been poisoned by drinking water from a stream polluted with tar washed from the main road. The evidence (see last volume of "JOURNAL," pp. 414, 685) was heard by Judge Shortt, who now forwarded his written judgment for Deputy-Judge Charles Haigh to read in his absence through indisposition. The judgment was to the following effect.

The case was argued on the understanding that all amendments were made in the pleadings necessary to enable either party to bring forward any legal ground of attack or defence. Two questions of fact were raised—first, whether the death of plaintiffs' cow was caused by swallowing tar or water containing tar; and, secondly, if so, whether the tar came from the defendants' road. The evidence on these points was conflicting; but he answered both in the affirmative. The questions of law were whether, under the circumstances of the case, the defendants were liable; it being admitted, or proved, that there was no negligence on their part. It was proved to his satisfaction that the tarring of the road was a proper and efficient method of repairing it, and more economical than the use of granite. The case of *West v. Bristol Tramway Company* was relied upon by plaintiffs as a decisive authority in their favour. In that case, the Jury found that it was not absolutely necessary for the defendants to tar the road when they did; and, secondly, that it was not absolutely necessary, but that it was reasonably necessary, for them to do the road as they did and at the time they did it. On these findings, the Court of Appeal held the defendants liable. His (Judge Shortt's) findings were that it was reasonable to repair the road with tar—this method being more economical than that previously in use; but he also found it was not absolutely necessary, as there was an alternative method (by granite) open to defendants. He considered himself bound by the finding of the Court of Appeal in the case quoted, and gave judgment in favour of plaintiffs for the amount of the claim, but with stay of execution for fourteen days. If an appeal be entered within this period, he further suspended all proceedings pending that appeal.

Mr. L. R. COKE, on behalf of plaintiffs, asked for costs on the higher scale; but to this Mr. H. J. BRACHER raised objection on behalf of the defendants.

His HONOUR decided to leave the matter over to the next Court, for Judge Shortt to deal with.

Recovery of a Gas-Meter.

At the Tottenham Police Court last Thursday, Charles Gordon, of Rosebery Gardens, Harringay, was summoned by the Tottenham and Edmonton Gas Company for detaining a gas-meter of the value of 30s. A fortnight previously (see *ante*, p. 50), the defendant was summoned for the same offence, and also for illegally disconnecting the meter. He was fined upon the latter summons; but the former was dismissed, as the Bench were not satisfied that a proper demand had been made for it. It was explained that since then an inspector of the Company had been to the house and demanded the meter; but the defendant still refused to give it up, as he claimed a lien on it. Mr. Hill, for the defence, said his client felt very strongly about his rights in the matter. A meter had been previously taken away from the house with 5d. in it, for which he had not had the equivalent in gas; and he brought an action against the Company. He took the present stand on what he considered to be public grounds. Of course, he had no right to detain the meter when he was refunded the money that it contained, which belonged to him. It seemed hard that a consumer was not at once repaid money due to him in such circumstances. Mr. Williams, who appeared for the Company, said the meter had to be tested, and then the money was returned. The defendant said the Company demanded the second meter two days after he had put eleven pennies in it; and he did not consider he had then burnt a pennyworth of gas. The Bench ordered the meter to be given up; the Chairman pointing out that any money found in it that was due to the defendant should be returned. Mr. Williams said this, of course, would be done.

Wandsworth and the Gas-Burner Bill.—A petition is to be presented by the Wandsworth Borough Council against the Gas Companies' Standard Burner Bill (No. 1), with the view of obtaining the insertion of provisions with respect to the testing of the calorific power of the gas supplied by the Wandsworth and Putney Gas Company. Other councils are to be asked to co-operate

MISCELLANEOUS NEWS.

GAS MATTERS AT BISHOP'S STORTFORD.

The Gas Company's Bill and the Council's Proposed Bill.

Practically the whole of the proceedings at meetings of the Bishop's Stortford Urban District Council which were held last Tuesday week had reference to the gas question. The first discussion took place respecting an item on the *agenda* "to consider the Gas Company's proposed Amalgamation Bill, and what action shall be taken in regard thereto."

The CLERK (Mr. T. Swatheridge) opened the discussion by stating that he had received a letter from the Sawbridgeworth Urban District Council agreeing that it was desirable that a conference of the Local Authorities interested in the Bishop's Stortford, Harlow, and Epping Gas and Electricity Bill should be held, and suggesting that the Bishop's Stortford Council should convene such a conference.

The VICE-CHAIRMAN (Mr. H. Kent) thought it was essential that they should place themselves in a position to negotiate with the Gas Company. It was the duty of the Council to protect their interests while they had the chance. It was, he knew, no use arguing in reference to the price of gas; but he had obtained the last returns by the Local Government Board. When they analyzed these figures, they could find losses; but they found that with even a derelict company purchased from a group of financiers in 1903, the local authority were not making so much loss to-day. Furthermore, the fact was clear that when they aggregated the whole of the English and Irish gas companies, and also the municipal authorities supplying gas, they found that the average price charged by companies was 2s. 10¼d. per 1000 cubic feet, and by municipal authorities 2s. 6¼d. The position was such that they could go no farther upon the lines of the purchase of the undertaking; but they had it in their power to negotiate for conditions, or to ask Parliament to give them such conditions as they were entitled to. He moved that the Council lodge a petition against the Bill.

Mr. NEWEY, in supporting the motion (which had been previously formally seconded), remarked that, notwithstanding anything said to the contrary, the Gas Company could charge more than 4s. per 1000 cubic feet. It stated pretty plainly in the Bill that slot meters had to pay 5s. With regard to quality, so long as they received 16-candle power, it did not seem to matter what the gas consisted of. They ought to be in some measure protected, so that, even if it was 16-candle power, nothing should come through with the gas that was likely to be objectionable. There was another clause by which they would have to give two hours' notice in writing before they could test the gas. Supposing anybody were to receive by the first post an intimation from a Government Inspector that he was coming about 10 or 11 o'clock, they would be very thankful. He, however, did not think that the Government would dream of giving any such notice; and he did not see why the Gas Company should want two hours' notice to get the gas up to 16 or 19 candle power, or whatever it was.

Mr. HOLLAND said he was of opinion that they ought, as a Council, to get the very best terms they could from the Gas Company; but he still believed they could do it by conference, instead of taking the decided action of opposing the Bill. He knew, of course, that they had certain rights under the last Act. They would lose the power of purchase—that he was aware of; but there were certain other rights of theirs that would continue.

Mr. CARRUTHERS was in favour of a purchase-clause being inserted in the present Bill. He believed the townspeople were eager that the Bill should not go through, and that more than one of the Company's shareholders did not desire it, and regarded the matter as having been "more or less sprung upon them."

Mr. FOWLER: Can you say what the expense of the petition will be?

The VICE-CHAIRMAN: It depends upon what you have to do.

Mr. FOWLER: I know that; but what are you laying yourselves out for? If you spend £1000 for nothing, you will be publicly thanked.

Mr. WATERMAN: What did the petition cost last time?

The CLERK: I think the bill was taxed at about £225.

Mr. EDWARDS: But what did you get for the money?

The CHAIRMAN (Mr. J. L. Glasscock) and Mr. FOWLER: Nothing.

The VICE-CHAIRMAN: I beg your pardon; we got the right to purchase.

Mr. HOLLAND: It seems to me that if we oppose the Bill we shall and ourselves in an expenditure of £200 or £300.

Mr. FLINN: It has been stated that we are likely to lay ourselves out for a large expenditure. Mr. Kent has shown that the lodging of the petition is a minor thing; and it clearly remains for the Gas Company to negotiate with us to the extent that opposing the Bill should be avoided. It is quite clear that if the Gas Company do not try and meet us, any expense that is incurred will be caused through them, and the ratepayers will have them to thank for it.

Mr. NEWEY: Is it a correct interpretation that the £50 shares were made £100, and now the £100 are made £140? Does that not give a larger range for dividend?

The CHAIRMAN: They would not get any more dividend really.

The VICE-CHAIRMAN: In the future it looks as if there is going to be something in the nature of 20 per cent. on the original shares. Surely it is the duty of the Council to see we are not bled to that extent.

Mr. CARRUTHERS: The Bill is going to cost the Gas Company a lot of money; and I take it the consumers will pay for it. We ought to have gas cheaper.

Mr. PRYOR, in announcing his intention of voting against the motion, expressed the opinion that it would not be wise to spend a large amount of money opposing the Bill. The bigger the undertaking, the cheaper and better would be the supply of gas. There were on the Board of Directors gentlemen who took a deep interest in the town.

The CHAIRMAN: I have not heard to-night of anything excepting two small items suggested as likely to detrimentally affect the interests of Bishop's Stortford. Mr. Kent has mentioned monopoly—none of us would look with favour on that. But the objection to monopoly is more or less sentimental; and whatever steps we might take in opposing the Bill, I do not think the House of Commons would listen to us on the grounds of objection to a monopoly. Mr. Kent did not indicate any clause that should be amended; and therefore I think, before we commit ourselves to lodging a petition, we ought at least to know what we want and what we intend to get. The points mentioned by Mr. Newey do not seem sufficiently strong to warrant the taking of the action suggested. With regard to what has been said about the purchase clause, I think we ought to profit by the experience we had four years ago. We know very well that we started on the lines that some are proposing to do to-night; and our aim was to get the purchase clause inserted. We wanted the purchase clause put in the Bill; and we lodged a petition and spent something like £300 to get it. But we knew very well at the time, with the Council as then constituted, that there was not the remotest chance of the undertaking being purchased; and therefore I consider, from the ratepayers' point of view, that we wasted our money. I shall not support a reckless and useless waste of money in opposing the Bill.

Mr. HOLLAND moved, and Mr. FOWLER seconded, an amendment that they should ask for a conference with the representatives of the Gas Company.

After some further discussion, the amendment was put and lost—four voting for and five against it. The original resolution that steps be taken to lodge a petition against the Bill was then carried. It was, however, arranged that the Clerk should incur no expense until he had received further instructions from the Council. Subsequently, a further resolution was carried unanimously, to the effect that steps should be taken to open up negotiations with the Gas Company.

A Special Statutory Meeting of the Council was then held, pursuant to notice, for the consideration of the following resolutions:—

(*a*) That the Council do apply in the next session of Parliament for an Act to enable the Council to purchase the undertaking of the Bishop's Stortford and District Gas Company, to supply gas, and for other purposes.

(*b*) That the expense be defrayed in the first place out of the general district rate, and ultimately out of money to be borrowed under the provisions of the Act.

The VICE-CHAIRMAN said he recognized that it was an absolute impossibility to secure a majority of the whole Council; and therefore the resolution formerly passed (see "JOURNAL" for Dec. 14, p. 762) fell to the ground. He was sorry there was no chance of going to the electors for a vote on the question of purchase. He, however, formally moved the adoption of the first resolution.

On being put to the vote, five voted for it and five against.

The CHAIRMAN thereupon announced that it had fallen through.

The CLERK said there was no necessity to put the second resolution, as they were not proposing to promote any Bill.

Some discussion then took place with regard to the expense already incurred; and it was decided that the Clerk should consider how the Council stood in the matter, and, if necessary, place a resolution on the *agenda* for the next meeting.

At the quarterly meeting of the Essex County Council, the Parliamentary Committee reported that they had directed that the necessary notices should be given under the Borough Funds Acts, prior to that meeting, to enable the Council to spend a sum not exceeding £500 in opposing the Bishop's Stortford, Harlow, and Epping Gas and Electricity Bill. Alderman Brooks said he was very glad to assure the Council that this matter was not likely to cost the county any very serious sum of money, if anything at all. A study of the Bill showed that the promoters had conceded to the county of Herts all that they in Essex were likely to require. Why they had not included in the Bill a clause giving the same measure of protection to Essex, he did not know; but it was hardly conceivable that they would refuse to Essex what they had already conceded to a neighbouring county, though it was necessary for them to have the power of opposition. He had had put into his hands a letter from Mr. Jones, of Ongar, who evidently did not understand the object of this provision. They had had resolutions of this character year after year; and, as the Council knew, it was only when they had failed to obtain concessions in other ways that they had gone to actual opposition in Parliament. He asked them to authorize the Committee to spend the money if necessary; but he did not think they would be actually called upon to expend it. A resolution to this effect was adopted.

HOYLAND DISTRICT COUNCIL AND THE GAS-WORKS.

Purchase Scheme not Sanctioned.

There was a crowded meeting of the ratepayers of Hoyland in the Town Hall, on Monday last week, for the purpose of considering the proposal of the Urban District Council to purchase the undertaking of the Elsecar, Wentworth, and Hoyland Gas Company. Mr. M. T. KENWORTHY, the Chairman of the Council, presided.

The CHAIRMAN explained that in October, 1906, the Council appointed a Sub-Committee to approach the Directors of the Company and discuss with them several grievances. These were chiefly the price of gas, which everybody agreed was too high; the quality, which was cause for much dissatisfaction; the public lighting arrangements; and the breaking-up of roads by the Company. Discussion was continued at a second meeting, when the Chairman of the Gas Company said: "Why do you not buy the gas-works; then you could remedy these defects." That meeting was held on Dec. 11, 1907; and this was the first intimation they had of the idea of purchase. The Council had considered the matter at great length, and eventually appointed a Sub-Committee to supply the Council with the details. This was done, and the Council decided then to call in an expert to report to them as to the value of the works, &c. Mr. Newbigging was acknowledged to be one of the first gas experts in the country; and on his recommendation, the Council

offered the Directors £25,200. This was arrived at on the usual basis of 25 years' purchase of the maximum profits earned. The Company had authorized share capital to the amount of £24,000, of which £12,000 had been issued and was fully paid-up in the form of consolidated stock. The maximum dividend of 10 per cent. on £12,000 was £1200; and this amount multiplied by 25 made a total of £30,000 as the purchase price. Assuming that the works and mains were in a condition to continue earning the maximum dividends, the £30,000 would represent the value of the undertaking. But, as a matter of fact, these were far from being satisfactory. This sum was offered to the Company; and they replied that they required £33,000, which figure was afterwards amended to £32,500. Having given particulars of the Company's financial position, the Chairman said he acknowledged that the total price (£34,100) was a high one, but it was the lowest possible; and even at this the purchase would be, in his opinion, a profitable undertaking. He was encouraged in this opinion by the fact that there were private individuals who were prepared to give the price named, and more, for the concern. In this connection, comparisons of prices paid by local authorities in recent years would be interesting, and would support his contention. These he proceeded to give. Continuing, he reminded the meeting that in their project the Council were acting on the advice of Mr. Newbigging, and he was convinced that not only could the price of gas, which was now 3s. 7d. per 1000 cubic feet—a figure much above the average—be reduced, but they would also be able to contribute a good amount to the relief of the rates. They would also be repaying capital at the rate of £850 a year; and in time the works, paid for out of profits, would belong to the community. He understood that many who were in the meeting had come to oppose the scheme; but he hoped they would hesitate. He reminded the meeting that some years ago the Local Board had approached the Gas Company in regard to the purchase of the undertaking; and it was now considered that their decision not to do so had been a gross mistake. The works would never be obtained on better terms than now. He had pleasure in proposing that the Council should proceed to complete the purchase.

Mr. E. James seconded the motion.

Mr. W. J. Lazenby, the Commercial Manager of the Hoyland Silkstone Colliery, in a speech of some length, opposed the motion. He said the ratepayers were being asked to buy a business which was already declining, and the very existence of which forty years hence was doubtful. The amount which the Council had agreed to pay for the works as they stood was £27,000; and they were to take over the mortgage of £1000. The costs of the Act and expenses incident to the purchase of the undertaking were expected to amount to £1000; and consumable stores were estimated to be worth £300; and for improvements and extensions to the undertaking, £4800 was to be borrowed. The total of these figures was £34,100. Nothing had been provided for working capital. The speaker proceeded to deal in detail with the financial aspect of the question, and concluded by saying that, if he could believe that the purchase of the gas-works would be any benefit to the ratepayers or the consumers, he would support it most heartily; but he was regretfully driven to the conclusion that it would entail a very serious annual charge, for a long period of time, without bringing in return the slightest compensation. He urged the meeting, therefore, to consult the best interests of themselves, their children, and even their grandchildren, by most decidedly refusing their support to the promotion of the proposed Bill.

Mr. W. A. Durnford, the Commercial Manager of the Elsecar Colliery, supported the scheme; saying he was convinced that if the ratepayers decided against it they would regret it. The reluctance of the Gas Company to sell their undertaking was to him a decided reason for its purchase. Mr. Newbigging was the best expert on the question in the country; and he strongly recommended the Council to buy.

Mr. T. C. Newton, the Managing-Director of Messrs. Newton, Chambers, and Co.'s Collieries, and Dr. W. L. Allott suggested an adjournment; but the proposal was quickly rejected.

On the vote being taken, 12 were in favour of the scheme, and an overwhelming majority voted against it.

Commenting on the subject, the "Hoyland Express" says: "We are rather sorry that the scheme of the Hoyland District Council has fallen through. . . . Rarely is it bad policy on the part of a municipality to take over a gas concern. Gas is one of the most profitable of undertakings at the present time. Take this case of the Hoyland works. The outlay is put at something like £33,000. An Act of Parliament can be obtained, and the money raised and repaid in fifty yearly instalments of £686. The gas-works, well-equipped and in proper condition, are capable of earning £1800 a year. This means that they would be a source of immediate profit to the extent of £814 a year, without costing the ratepayers a single penny. That is money thrust deliberately into their pockets. With equal deliberation they have thrust it out."

CROYDON AND THE STANDARD BURNER BILL.

The Town Clerk of Croydon (Mr. F. C. Lloyd) has drawn up a report upon the Gas Companies Standard Burner Bill (No. 1), which the Croydon Gas Company, together with other companies, are promoting. After setting forth the provisions of the Bill, he proceeds as follows.

The substantial question for consideration is whether the adoption of the standard burner, which is said by gas experts to appreciate the gas, will injuriously affect the interests of the consumer by the lowering of the standard candle power or otherwise. I understand that the quality of the gas supplied is the important factor in determining the question of how far, if at all, the adoption of the standard burner will affect consumers in any particular area, as the better the quality of the gas supplied, the less the standard burner appreciates the gas—*e.g.*, in the City of Liverpool, which is one of the county boroughs affected by the proposals of the Bill, I find upon inquiry that the standard burner appreciates the gas to the extent of between 2 and 4 candles in the total illumination, with the result that the quality of gas required to give the statutory 20-candle power through the standard burner will only suffice to give from 16 to 18 candles through the existing prescribed Liverpool burner. Therefore the view is held in Liverpool that if a standard burner were adopted there, the consumer would suffer a reduction of 2 to 3 candles in illumination; and that, failing a corresponding reduction in price, such new burner would be detrimental to the consumers' interest.

After considering the proposals of the promoting Companies, I communicated with the Secretary of the Croydon Gas Company, stating that I had received communications from several of the towns affected, from which it appeared that they regarded the proposals of the Bill with apprehension, on the ground that the same would injuriously affect the consumers, and asked him to be good enough to inform me whether his Company would be prepared to compensate consumers in any way, and, if so, how. I have received the following reply from the Secretary (Mr. W. W. Topley):—

> My Directors are aware that the Local Authorities in some few of the districts affected by this Joint Bill are in communication with one another, in the belief that its proposals may possibly act prejudicially to consumers. They feel sure, however, that such apprehensions as any Local Authority may feel can only be based on an incomplete knowledge of the facts.
>
> Enclosed is a list of 76 cases in which during the last few years the change of standard burner proposed in the Bill has been authorized by Parliament. The point to which my Directors wish to draw your attention here is that in no case, as far as they know, has any condition in the nature of compensation been attached by Parliament for protecting the interests of the consumers by reason only of the altered method of testing; it having been recognized that under the regulations which now apply generally to the relations between gas companies and consumers, the greater part, if not the whole, of any benefit which a company may reap from the change of burner automatically finds its way to the consumer.
>
> In the case of this Company, if and when any saving arises from the use of the new burner, its result will be to enable the Company to take, earlier than would otherwise be the case, a step the Directors are naturally desirous of taking at the earliest possible moment—that of effecting a reduction in the price of gas.

The question whether the adoption of the standard burner will, in fact, be detrimental to the interests of the consumers of gas in Croydon, is one that can only be answered by an expert gas engineer, who has ascertained by analysis the quality of the gas supplied by the Company; and it must be remembered that the problem is now complicated by the use of incandescent burners.

As to petitions against the Bill, the last day for presenting petitions in opposition will, if the Bill commences in the House of Commons, be on Feb. 12, and if in the House of Lords on Feb. 19; and in the event of the Corporation deciding to oppose the Bill, definite instructions to do so should be given me at the next Council meeting.

THE RATES AND PUBLIC ELECTRIC LIGHTING.

Among the correspondence in a recent issue of the "Bexhill Chronicle," there is a long letter on the subject of the "High Cost of Public Electric Lighting," which will be read with interest. The author, who is evidently well informed on the question with which he deals, writes under the *nom de plume* of "Assoc.M.Inst.C.E."

I notice from your report of the recent Local Government Board inquiry that the unusually efficient Inspector, Mr. Hooper, called attention to the high cost of public electric lighting. And no wonder; for in his investigations about the country he must have been much struck by the fact that, generally speaking, where public authorities own the local electric undertakings, the cost of public lighting is excessive. Mr. Hooper was probably not informed that the present lighting rate at Bexhill represents 4d. in the pound, or 21 per cent. of the general district rate of 1s. 7d.—being, in fact, the highest item, with the exception of that of highways. It is as certain as anything can be, that if an Electric Light Company were in fair competition with the Gas Company, the ratepayers would not be called upon to pay this extravagant rate for public lighting. Competition is a *sine qua non* with municipal work in the ordinary way. Yet it is a curious fact that this is being ignored in the important matter of public lighting; and the price charged for the same is practically in the hands of the Electricity Committee.

It is true that the finances of the electricity undertaking show improvement; and the Committee are to be congratulated upon starting the very necessary depreciation and reserve fund. But how has this apparent improvement been brought about in the face of considerable capital expenditure and the fall in custom due to metallic filament lamps? To me, the reason seems clear, for, if I remember rightly, there was a deficit on the undertaking year by year until the charges for public lighting were increased; and though these have subsequently, perhaps, been modified, owing to the introduction of metallic lamps (which take less current), the fact remains the same at Bexhill as in many other places in the country where municipal trading in electricity is indulged in—that the ratepayers, some of whom do not, and cannot, receive the slightest benefit from the undertaking, have to pay indirectly to keep the concern going. And the ratepayers pay instead of the consumers of electricity, who surely are the people who should have to pay for what they have—more especially as electricity is by no means a necessity, in the same sense as water, for instance,

It is almost amusing to read the remarks attributed to the Chairman of the Electricity Committee, who suggests that, contrary to general opinion, electricity for public lighting purposes is being supplied at under the average cost. And yet his Committee are still anxious to do the lighting, and continue to heap up capital expenditure under this head. From your report, I gather that the average cost per unit is 3·86d., and that the charge for public lighting (which includes all items) is 3·75d. But as this is such a bad bargain, why do not the Electricity Committee (excluding the arc lighting, for which there may be some justification for additional expense) offer the same sum of money to the Gas Company as they receive, for providing an equal, or probably a

better, light. Let them do so, and they will find that they will have to raise the price of current to private consumers to make ends meet; and, of course, from an electrical point of view, a long-hour consumer such as public lighting furnishes (approaching more the ideal) should receive every consideration, and not be charged top price.

At Hastings, to which reference was made at the inquiry, and where the record of the electricity undertaking in the hands of the Corporation has been a disastrous one, there has recently been an endeavour to apparently improve matters by converting certain gas-lamps for the use of electricity, much to the annoyance of those ratepayers who are inconvenienced by the resulting inferior lighting. In this case, it is simply not competition, but preferential custom. But in order that the Electricity Committee could secure the work, they had to price the lamps the same as the Gas Company received for them; and this works out at 3·04d. per unit, including all charges other than interest. On the other hand, when the price to private consumers was recently increased, the price of current to the public arc lamps was also increased; and the total cost per unit of current, covering all charges, amounts to 6·66d. This last charge will be reduced after certain charges are paid off; but it will be observed that the figures are utterly inconsistent, and have but one motive in view—namely, to inflate the revenue at the cost of the ratepayers, instead of at the cost of the electricity consumers.

GAS POISONING OF A BELFAST ALDERMAN.

Electric Wire Fuses a Gas-Pipe.

On Saturday, the 8th inst., the City Coroner of Belfast (Dr. James Graham) opened an inquiry into the circumstances attending the death of Mr. John Rooney, an alderman of the Corporation, which occurred the previous day at his premises in the city. Among those present were Mr. J. A. Doran, J.P. Chairman of Gas Committee), Mr. Robert Sharpe (Gas Engineer and Manager), Mr. A. M'I. Cleland (Chief Inspector), and Mr. T. W. Bloxam (City Electrical Engineer).

Mr. P. S. BRADY represented Mrs. Rooney; Mr. JOHN M'CORMICK (Town Solicitor) appeared for the Corporation.

Mrs. *Mary Rooney* deposed that on the previous evening she went to the room in which her husband usually slept in the afternoon, for the purpose of calling him. There was a very strong smell of gas; but a light was burning. She went over to her husband, and raised his head, but it fell back. She then opened the door and two landing windows, and called for the ambulance. The gas appeared to be turned full on, though it was only burning dimly—about half strength.

Mr. BRADY said he had no questions to ask the witness. Of course, all their resources were at the command of the Coroner and the Jury to assist in discovering the cause of death. They placed themselves unreservedly at their disposal.

The CORONER said it was his intention to have a full investigation into the whole circumstances of the case; in fact, he had instructed two experts—one to make an examination of the dog which was found underneath the bed, and the other to state what was the exact composition of the gas. He did not wish to go into the particulars that day; but he thought it would be well to have a full investigation. They had so many gas-poisoning cases in Belfast that he thought it was his duty and that of the jurors to investigate this one, with a view to seeing if anything could be done to prevent the occurrence of these troubles. He might state, in regard to the evidence they had had, that no doubt there was a leakage of gas caused by some fusing between an electric light wire and the gas-pipe.

Mr. BRADY said they had a witness who opened the floor of the room in which the death occurred; and if it would meet with the approval of the Coroner, he could be examined as to the condition in which he found the room that morning.

The CORONER: Certainly; it will explain the circumstances.

John M'Cullough, a gas-fitter, stated that the floor of the room in which Mr. Rooney had been lying was opened that morning and the gas-pipes were examined. A pipe ran from one side of the room to the other, and parallel with it, at a distance of about 4 inches, was an electric wire covered with metal sheathing. From the pipe a branch led to a gas-jet which was burning. The wire went over the branch, touching or almost touching it. At the point of contact there was a hole in the gas-pipe, which was melted away about 3 inches. The under side of the flooring was scorched. He was the plumber who put in the piping. He had a free hand, and did the work in the best possible manner.

Mr. BRADY said that, in justice to the electric wire fitter, he might state that he did his work on the same conditions; he put in the best material. They had given the City Hall officials notice of the matter, and they had attended to give any assistance in their power.

The TOWN SOLICITOR said before the inquiry was adjourned he should like to express, on behalf of the Corporation, the deep sympathy of every member with the family of the late Alderman Rooney in their sad bereavement, and also their profound regret at the occurrence.

Mr. DORAN testified to the kindly and generous disposition, as well as to the business capacity, of the late alderman, whose death he regarded as not only a personal but a public loss. If there was any information to be obtained from the Gas Committee or any of the officials, he would, as a duty he owed to his late colleague, see that it was placed before the Coroner and the Jury, so that the inquest, when finished, would give satisfaction as far as possible to the deceased's friends.

Mr. BRADY said, on behalf of Mrs. Rooney and the family, he thanked those who had spoken so kindly of the deceased. With regard to the sad occurrence, they did not say the Corporation were in any way responsible. It was quite clear, from the examination that had been made, that, no matter what sort of gas was passing through the pipes, the volume that escaped was so great that death would have resulted. The cause of the leakage was perfectly obvious—the fusing of the electric wire, and the consequent melting of the gas-pipe.

The inquiry was then adjourned till last Thursday. On the resumption of the proceedings,

John Cunningham, who had been in the service of the deceased for fifteen years, stated that Alderman Rooney was in the habit of going upstairs every afternoon for a nap. About ten minutes past six on the evening of the 7th inst., he heard a scream from Mrs. Rooney. He ran up to see what was the matter; and he heard her say that her husband was poisoned by gas. He assisted in carrying the deceased out of the room, and laid him in the passage. They put pillows under his head and rubbed him. The ambulance arrived a few minutes later, and he was removed to the hospital; but witness believed he was dead when taken from the room. There was a very strong smell of gas in the room. The gas-jet was alight, but the flame was only flickering—about the size of a candle light.

Dr. *Michael Aicken* stated that about half-past six o'clock on the evening in question he received a message by telephone, asking him to go down to Alderman Rooney's business premises. A few seconds afterwards he had another message from Mr. Brady telling him to hurry to the Royal Victoria Hospital. He did so, and arrived at practically the same time as the ambulance. He examined the body in the emergency-room, and found no external marks of violence. There was a little blood and froth from the mouth and nose, and the face was congested and the pupils of the eyes dilated. He believed Alderman Rooney had then been dead about an hour-and-a-half. He (witness) afterwards made a minute examination of the bedroom. There was a shocking smell of gas, and they searched for the escape, but could not find it. On looking under the bed, he found the body of the dog. He was of opinion that death was due to asphyxia, following carbon monoxide poisoning.

Dr. *M'Kenzie*, of the Royal Victoria Hospital, gave corroborative evidence, and agreed with Dr. Aicken's opinion as to the cause of death. He thought death occurred about an hour before deceased was taken to the hospital.

Dr. *W. J. Wilson*, Lecturer in Hygiene at the Queen's University, stated that, at the request of the Coroner, he, in conjunction with Mr. Totton, made, on the 8th inst., a post-mortem examination of a dog stated to have been found in a bedroom at the late Alderman Rooney's business premises. Witness described the appearance of the dog, and said that when the blood was diluted it presented the cherry-red colour produced by the action of carbon monoxide poisoning. Spectroscopic and chemical analysis confirmed this diagnosis. When the blood was examined by Haldane's carmine method, it was found to be saturated with carbon monoxide to the extent of 76 per cent. Analyses of the gas supplied to the city were also made, for the purpose of ascertaining the percentage of carbon monoxide it contained. Four samples were taken from an ordinary gas-bracket—one in the forenoon, two in the afternoon, and one in the evening. The analysis of each sample resulted as follows: 19·9 per cent., 21 per cent., 20·6 per cent., and 19·7 per cent.—the four tests giving an average of 20·3 per cent. of carbon monoxide. The percentage of carbon monoxide in ordinary coal gas, free from admixture with carburetted water gas, was usually found to be from 6 to 8 per cent. Therefore the city supply contained at least 12 per cent. of carbon monoxide above the average for coal gas. The experiments of Professor Lorrain Smith had shown that in cases of gas poisoning it was carbon monoxide alone which was the lethal agent. The Departmental Committee on Water Gas, which reported to the Home Office in 1899, recommended that the limit of carbon monoxide in gas supplied during the night hours should be 12 per cent. Any escapes of ordinary coal gas would, under certain circumstances, be dangerous to life, owing to the presence of the percentage of carbon monoxide given above; but when carburetted water gas was mixed with coal gas to such an extent as to raise this percentage to 20, the danger was, of course, increased. Dr. Haldane, one of the experts on the Departmental Committee, had shown that deaths from carbon monoxide were enormously more frequent in cities using coal gas mixed with carburetted water gas than in those in which ordinary coal gas only was consumed. From experimental and statistical data, he concluded that the number of accidents referable to the use of mixed gas would appear to increase approximately as the cube of the gain in percentage of carbon monoxide. Thus, if the percentage of carbon monoxide were increased from 6 to 12, the chance of being poisoned was not twice, or even four times, but eight times as great as before the increase; and if the carbon monoxide became three times as abundant as before, the chances of being poisoned were increased no less than twenty-seven fold.

Mr. BRADY: Am I to understand from your evidence that there was an excess of 12 per cent. of carbon monoxide in the gas supply over the amount recommended by the Committee you mention?

Witness: The percentage in ordinary coal gas is 6 to 8, and the Committee recommended that the percentage present in a gas supply should not exceed 12 per cent. during the night hours. The samples we analyzed contained 8 per cent. more than was recommended by the Committee.

Mr. M'CORMICK: As I understand it, there is 6 to 8 per cent. of carbon monoxide present in ordinary coal gas? Am I right in saying that this is quite sufficient to produce death if inhaled?

Witness: Yes; if inhaled sufficiently long.

And the only difference is that one is a little more deadly than the other?—I would not say a little more; I would say more deadly.

Have you any doubt in this case that if the gas had been ordinary coal gas death would have ensued?—I think the chances of Mr. Rooney would have been three times as good if it had been ordinary coal gas.

That is a speculation?—Yes; but we know, as a matter of fact, of many instances in which people have been exposed all night to a considerable escape of coal gas, and yet have revived under proper medical treatment.

The medical evidence is that Mr. Rooney had been dead probably an hour-and-a-half before he arrived at the hospital. Now, suppose he was for this time exposed to an escape of coal gas alone, what would his chances be?—Well, one does not know exactly how much of this gas escaped or was diluted with air. There was a chimney in the room, and if the skylight were open it is possible there was a good dilution of the gas going on; so that a person might breathe the gas for some hours without being suffocated if it were pure coal gas.

Do you suggest that a man might inhale coal gas for an indefinite period?—If it were diluted. You must remember that the burner was

still alight in the room, and there must have been a considerable quantity of oxygen present to feed the flame.

Are you aware that carbon monoxide reveals itself by the pungency of its odour—that it is much more pungent than ordinary coal gas?—I think they have pretty much the same smell.

In further cross-examination, witness said he quite agreed with the report of the Departmental Committee that the danger from water gas mixed with coal gas only arose when it escaped, and not when it was consumed. Except the risk of poisoning when the gas escaped, it was not more dangerous than ordinary coal gas. He had seen the percentages of water gas used in English towns, and quoted some of them.

In answer to Mr. BRADY, witness repeated that if the gas had been ordinary coal gas, Mr. Rooney's chances of being alive that day would have been three times as good as they were.

Mr. *J. Harold Totton*, B.A., B.Sc., the County Analyst for Armagh, corroborated this evidence. In answer to a juror, he stated that, in his opinion, deaths from gas poisoning were not so numerous when coal gas only was used as they were now; and this was the reason for having the present investigation.

Mr. *Robert Sharpe*, the Corporation Gas Engineer and Manager, examined by Mr. M'CORMICK, stated that the carburetted water gas in Belfast differed in no way from that manufactured in any of the large centres in the United Kingdom. Carbon monoxide was a necessary ingredient, and it was found in no greater percentage in the Corporation gas than was the case in other towns. It contained about 32 per cent. He had made inquiries as to the percentage of the mixture of carburetted water gas and ordinary coal gas in other towns, with this result: Liverpool, 50; Bath, 50; Lea Bridge, 50; Dublin, 51; Southgate, 52; Tottenham, 52; Barking, 50; Southend, 50; Southport, 51; North Middlesex, 67·55.

Mr. M'CORMICK: Belfast is lower than all the places that you have mentioned?

Witness: Yes. For the three months October, November, and December, our average was 46·11 per cent. of water gas and 54 per cent. of coal gas.

Mr. M'CORMICK: There was a question asked as to the increase of deaths from gas poisoning since water gas has been used; but has there not been a very large increase in the consumption of gas generally?

Witness: Yes. I might say there is an increase of 7 or 8 per cent. all over the country each year. We have enormously added to the number of our consumers, especially since the introduction of prepayment meters, of which I think we have 24,000 in Belfast. With this increase, I should naturally expect there would be an increase in the number of deaths.

Have you any reason to suppose that the proportion of deaths is greater?—No.

In reply to further questions, witness said the use of water gas reduced the price of gas. Water gas revealed itself by its pungent odour. One cubic foot in 10,000 cubic feet of air would be at once detected? He tested the pipe which had been fused under the floor of the room, and calculated that on the evening in question it was discharging gas at the rate of about 3 cubic feet per minute. His theory was that, as the floor was covered with linoleum, the gas found its way along the joists and escaped round the skirting of the wall at the head of the bed. He thought Mr. Rooney was lying in the full force of the volume of escaping gas. Death must have ensued in ten minutes or a quarter-of-an-hour.

Mr. BRADY asked if the gas-piping and the electric light wire were laid in contravention of any regulation of the Corporation.

Witness replied that the Corporation had no powers with regard to the laying of pipes throughout a house. Their responsibility ended at the meter.

Was the arrangement you saw highly dangerous?—It was. There should always be a space between the gas-pipe and electric light wires; and in this case they were touching.

A model was produced in which the metal tube containing the electric light wire was seen touching the gas-pipe.

Witness explained that a short-circuit caused the fusion of the gas-pipe, and the sparks set fire to the escaping gas, and combustion lasted until the air in the space between the joists was consumed. Sufficient gas made its way through to keep the jet in the room alight. The tube containing the wire should have been at least an inch away from the gas-pipe, or have been properly insulated.

Mr. BRADY: Do you think it would be any safeguard to the public if the Corporation had control over fittings of this kind?

Witness: They have such control in some cities.

The CORONER asked if it were not the fact that it was because such large quantities of gas had now to be supplied that water gas had to be used?

Witness: Yes. We have to do it, and we must do it in future, whether we like it or not. We were very hard pressed in December to keep up the supply; and had it not been for the water gas, we could not have done so. If we had other means, we would use every endeavour to keep down the supply of water gas as far as possible. We do not wish to send out more than we can help; but we must do it when the time comes.

The CORONER said Mr. Sharpe had answered in a most straightforward manner all the questions put to him.

Mr. *Thomas Bloxam*, the Engineer to the City Electricity Department, stated that the class of wire employed in electric lighting was a most important factor in the prevention of leakage. He had examined that used in the premises in question, and found it of quite a superior class—in fact, if a contractor were so disposed, he might put in a very much cheaper description of wire. The only mistake made was the running of the ⅜-inch branch gas-pipe, and allowing it to come in contact with the casing carrying the electric wire. If the precaution had been taken to keep it an inch away, there would have been no leakage of electricity, and no puncturing of the pipe, and the sad accident would have been avoided.

The CORONER: The branch pipe had been recently added, I believe?

Mr. BRADY: It was put in as recently as the 9th of November; and the other work was done a couple of years ago.

The CORONER said he hoped the Jury would be satisfied with the evidence in this most unfortunate and lamentable case. It was unnecessary for him to say anything now concerning the sad death of Alderman Rooney, as sympathy had already been extended to his family by them. When he (the Coroner) was a member of the Corporation, Mr. Stelfox (the former Gas Engineer) made a report stating that, owing to the limited accommodation for the manufacture of gas and the want of space for extension, the inhabitants would some day find themselves in darkness. Mr. Sharpe and Mr. Bloxam both felt this accident very much.

Mr. BRADY desired to thank the officials of the Corporation for the trouble they had taken and the courtesy they had shown.

The CORONER said Mr. Sharpe had to supply the city with gas, and there were no other means of keeping up the supply than by the use of water gas; but there was no question at all that the number of deaths had increased since the use of this gas.

The Jury, after a short deliberation, returned a verdict that the deceased had died from asphyxia, following carbon monoxide poisoning, due to inhaling gas from an escape caused by an electric wire fusing the gas-pipe. They added a rider stating that they were of opinion that more care should be taken in laying gas-pipes close to electric wires.

The CORONER: Would you like the Corporation to get a clause or a bye-law to enable them to supervise the laying of gas-pipes and electric wires?

The FOREMAN: No; it does not amount to that.

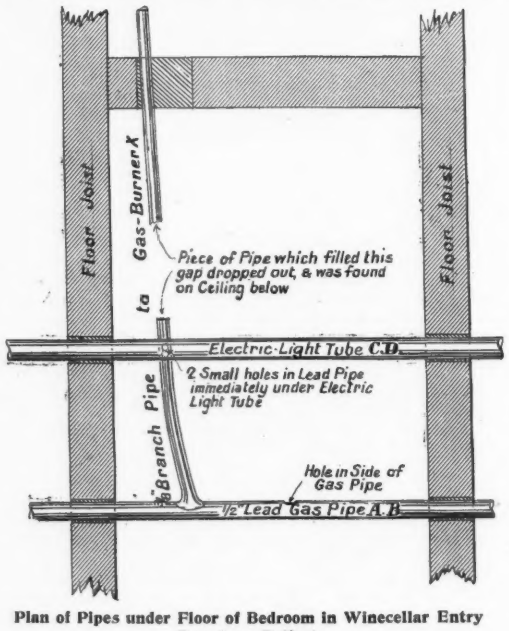
Mr. M'CORMICK: It would be a very big thing for the Corporation to undertake to supervise every house in Belfast.

The CORONER said he was glad Mr. Bloxam was in a position to say that the materials used in the electric light installation in the premises were of a first-class description.

The proceedings then terminated.

Report by the Superintendent of Mains.

A report on the accident has been made by Mr. A. M'I. Cleland, the Superintendent of Mains. He first explains that the room in which the deceased was found was lighted by one flat-flame burner fitted on a bracket fixed over the fireplace, 6 feet from the floor, and then gives particulars of his examination of the premises the day after the occurrence. On the flooring-boards being removed, the cause of the disaster was at once apparent. The bracket was supplied by a ⅜-inch lead pipe passing under, and in contact with, a ¼-inch iron tube enclosing electric wires. The former pipe was taken off a ½-inch lead pipe. The arrangement is shown in the accompanying diagram. At the point where the ⅜-inch pipe had been in contact with the iron tube, two holes, each rather less than ⅛ inch in diameter, had been made in its upper surface.


Floor Joist
Gas-Burner
to
Piece of Pipe which filled this gap dropped out, & was found on Ceiling below
Floor Joist
Electric-Light Tube C.D.
2 Small holes in Lead Pipe immediately under Electric Light Tube
⅜ Branch Pipe
Hole in Side of Gas Pipe
½" Lead Gas Pipe A.B.

Plan of Pipes under Floor of Bedroom in Winecellar Entry Premises, Belfast.

At a distance of 1 inch from the iron tube, there was a gap of 3 inches in the ⅜-inch pipe; the broken ends showing ragged edges, but full apertures. There was also a hole about ⅛ inch in diameter in the side of the ½-inch pipe, and 3 inches from the point at which the ⅜-inch pipe had been taken off. The boards above the gap in this pipe were burnt and charred to a maximum depth of ⅝ inch, and over an area of 3 to 4 inches. Mr. Cleland comes to the conclusion that electrical action holed the ⅜-inch pipe. The boards were separated from this pipe by a space of only ⅛ inch; and a hole 1-64th of an inch in diameter would have allowed a flame to issue more than long enough to ignite the boards. Once the gas was ignited at the hole, the iron tube immediately above caused the flame to be deflected in two directions—one upwards, igniting the under surface of the flooring, and the other playing about the side of the ½-inch lead pipe. The burning and glowing boards gradually baked the portion of the ⅜-inch pipe immediately beneath them; but before the pipe was sufficiently softened to be ready to drop of its own weight, the air in the cavity was so heavily charged with carbonic acid that the gas could no longer burn. Everything was now in train for the gas to find its way beneath the floor and into the room. A certain portion of it shot across the gap in the ⅜-inch pipe and kept the jet in the room going, though feebly; but a far greater portion followed the line of the pipe over the joists, up behind the skirting-board, and into the room through a hole in the plaster just above the board.

SULPHATE OF AMMONIA MARKET.

Messrs. Bradbury and Hirsch's Review for the Past Year.

We have received from Messrs. Bradbury and Hirsch, of Liverpool, a copy of their "Review of the Market for Sulphate of Ammonia during 1909;" and, as on similar occasions, we extract from it the portions which chiefly interest our readers.

In their "Review" for the year 1908, Messrs. Bradbury and Hirsch took occasion to refer to the condition of trade and industry during that period; and they described it as having been the worst in any recent year. Supply had been in the process of adjustment to consumption by means of reducing output and working off surplus stocks in the hands of producers and distributors, and trade and industry had been suffering accordingly. They thought, however, that the year had gone far to bring about this adjustment, and that in 1909 production might again be raised to the level of the year's consumption; stocks having been reduced to something like a working level. At the time, however, they could not see that more could be looked for; and now that 1909 has passed, it does not seem to them that much more than they suggested has been achieved. It cannot be said that the year was a good one for farmers in the United Kingdom. The spring was fairly open and seasonable, but the summer and autumn were dull and wet; and though crops were sufficiently abundant, they were, on the whole, not very satisfactory in either quality or condition. Prices were, however, good where quality and condition were right; and, if the year's working cannot be considered as having been good, it cannot, on the other hand, fairly be described as having been distinctly bad.

At the end of 1908, it was possible to make a much closer estimate of the probable supply of nitrate of soda for January-April than was the case at the end of 1907; the factors concerned being less perplexing. But the argument from the probable supply to the probable course of the market was rendered more difficult by the fact that no agreement for the renewing of the Combination of Producers, which was expiring at the end of March, had been arrived at, and by the further fact that 90,000 tons of the season's supply had been pooled for the purpose of regulating the available supply as the season progressed. The actual supply for January-April proved to be 997,000 tons. This was 16,000 tons less than was estimated by Messrs. Bradbury and Hirsch; but, as at the time they expressed some doubt as to whether their figures would be reached, they were not surprised to find they had rather overshot the mark.

There was nothing exceptional about deliveries in January; and there was no improvement upon the opening price of 9s. 6d. per cwt. In February, however, after a slight decline early in the month, there was an advance to 9s. 9d. per cwt.; the demand being particularly good. Deliveries continued on a heavy scale all through March, and the price became 10s. 3d. per cwt. In April, 10s. 4½d. was scored; and in May 10s. 6d., though supplies were always far more than enough. The high level of prices reached was due to the scientific handling of the supply—the 90,000 tons pooled and the other supply controlled by the large holders who were parties to the pool. In June, stocks were accumulating too seriously for the comfort of holders; and, notwithstanding the delivery of 120,000 tons from the ports, the price declined to 10s. 3d. per cwt., for ordinary quality, *ex* store at Liverpool. On the 1908 figures, with the Combination in force, the price steadily declined from 11s. 1½d. per cwt. in January to 9s. 10½d. per cwt. in June; whereas on the much heavier figures in 1909, with the Combination expiring at the end of March, and practically no prospect of its being renewed then, prices just as steadily advanced from 9s. 6d. per cwt. in January to 10s. 6d. per cwt. in May. From 10s. 3d. per cwt. in June, the price drooped to 9s. 9d. in July; and in August, though there was no further material increase in the stocks at the ports, there was a decline to 9s. 6d. There was no further alteration in values until October, when 9s. 3d. per cwt. was accepted. Shipments in November were exceptionally heavy—255,000 tons—and at the end of the month the visible supply was 93,000 tons ahead of that at the end of November, 1908; but the spot price remained 9s. 3d. per cwt. Shipments to Europe in December were substantially less than those during December, 1908; but there was no improvement in values—the closing price being 9s. 3d. per cwt.

The visible supply (stock and afloat) for the United Kingdom and the Continent at the end of 1909 was about 1,008,000 tons; while at the end of 1908 it was 923,000 tons, and of 1907, 702,000 tons. The present visible supply is, therefore, larger by 85,000 tons than it was at the end of 1908. What Messrs. Bradbury and Hirsch's friends are more concerned about, however, is the probable actual supply for the next four months; and, since a new element has been brought into the problem of estimating, the difficulty in estimating closely has been very much increased. In previous years shipments were strictly limited by agreement among producers. But since April last, production and shipments have not been limited in any way; and, consequently, one must expect that the quantity shipped early in the current year will only be limited by shipping facilities. After making allowance for losses at sea, something like 110,000 tons must be added to the present visible supply in order to get at the probable actual supply for January-April; and if this estimate happens to be approximately correct, the actual supply for the four months will be about 1,118,000 tons, or some 121,000 tons more than the actual supply for January-April, 1909. What are the prospects of increased consumption to correspond with the increased supply which must be reckoned upon? And what are the chances for the market, always remembering that last season's consumption left a stock at the end of April of 155,000 tons, or 40 per cent. more than was delivered from the ports in May. Messrs. Bradbury and Hirsch discuss these questions, and express the opinion that there will be a very marked increase in the consumption of nitrate over the coming season; but, inasmuch as heavier deliveries within recent months from Continental ports point to larger stocks already in the hands of distributors in the interior, they are afraid that the much greater consumption they reckon upon will not be enough to bring the available supply down to moderate limits. This being their view, and the heaviest arrivals being due a month earlier than were those last spring, they fail to see how prices are to be materially improved, especially as holders cannot find encouragement in the further forward position to maintain a firm attitude and carry heavy stocks.

Dealing next with sulphate of ammonia, Messrs. Bradbury and Hirsch say the situation at the beginning of the past year was decidedly interesting, though somewhat perplexing. It was certain that the Japanese demand, which was the dominant factor in the market over the early months of 1908, would be very much reduced, and it was by no means obvious from what quarters would come the increased demand necessary to absorb the extra supply thus rendered available. This was one thing. Another was the knowledge that there were in the hands of German producers surplus stocks to set against any diminution in German production there might be over the first half of the year. Then the price of nitrate of soda was relatively low in comparison with that ruling at the beginning of any recent previous year, and also with the price of sulphate of ammonia; so that in relative cheapness there was an inducement to revert to the use of nitrate. Unless, therefore, German sulphate producers persisted in holding for impossible prices, or unless the nitrate market made an upward move, the Continent was not a promising outlet for British sulphate. It was thought, however, that if Germany kept out of the Colonial and Spanish markets, where she was much in evidence over the spring season of 1908, this, with sustained demand for the United States, might go far to adjust the Japanese shortage in requirements from the United Kingdom. The authors show later in their report that there was a big advance in the price of nitrate of soda, which provided an incentive to a larger use of sulphate of ammonia; so that the Continent not only absorbed the German surplus stocks and current production, but made increased demand upon British production as well. And Germany substantially reduced her exports; so that extra Colonial and Spanish requirements from the United Kingdom, with an increased demand for the United States, went far to adjust the falling-off in shipments to Japan. The opening price in January was consequently more than maintained over the spring months. In order to allow of the movements of exports being conveniently traced, the usual four tables are given showing the shipments from January to March, April, June, and December respectively. From the last we take the following figures: To France, Germany, and Belgium, 49,142 tons; to Spain and Portugal, Italy, and the Canaries, 72,512 tons; to Holland, Java, British Guiana, the West Indies, and the Mauritius, 49,157 tons; to Japan, 49,275 tons; to the United States, 35,080 tons; and to other countries, 8875 tons—a total of 264,041 tons, as against 234,921 tons in 1908, 230,537 tons in 1907, 201,456 tons in 1906, and 189,349 tons in 1905.

The true significance of the January-December table is shown when it is read alongside that for January-June. When this is done, it is found that shipments to the Continent decreased no less than 14,193 tons in July to December, though, owing to shipments against old contracts, there was no decrease to Germany until October. The increase to Spain for the six months was 3959 tons; and, having regard to the exceptionally heavy shipments over the corresponding period in 1908, when Germany was out of the market, Messrs. Bradbury and Hirsch think this must be considered highly satisfactory, as must also an increase of 8262 tons to the United States. Apart from Java, where German competition has again made itself felt, shipments to the Colonies since June show a substantial increase; but the demand for Japan was, as during the same period in 1907, the dominant factor in the situation—the increase having been no less than 28,810 tons over that for July to December, 1908. The cause of the shrinkage in Japanese requirements over the early months of 1909 was well understood a year ago, though it is probable that it was under-estimated everywhere except in Japan.

Coming to the price of sulphate of ammonia during 1909, Messrs. Bradbury and Hirsch say that from £11 5s. per ton f.o.b. Hull at the beginning of the year it had advanced to £11 11s. 3d. per ton by the end of March, though in the meantime the total exports were less by 551 tons than the total for January to March, 1908. But the shipments in this period were only rendered possible by the draining of supplies to the utmost, causing an advance in price from £11 13s. 9d. per ton at the outset to £12 7s. 6d. per ton in April; whereas at the end of March, 1909, there were surplus stocks in the hands of producers which brought the price down to £11 5s. per ton in April, though there was an increase of 3540 tons in the exports in that month. Notwithstanding the heavy shipments, for the summer season, in May and June, the price dropped to £10 18s. 9d. per ton in June, recovering to £11 2s. 6d. per ton at the end of that month. So that the somewhat pessimistic view which Messrs. Bradbury and Hirsch took of the outlook a year ago was amply justified by events; and but for the upward movement in the nitrate of soda market, the price of sulphate of ammonia must, they say, have found a lower level than it actually reached. There was no special feature in the market in July and August—the price fluctuating between £11 2s. 6d. and £11 1s. 3d. per ton; but improved demand caused an advance to £11 7s. 6d. per ton in September. Increasing output brought about a decline to £11 2s. 6d. in October; and, notwithstanding heavy shipments, there was no recovery in prices in November, though the market assumed a very firm tone. In December, however, the demand from the outset being well sustained, prices gradually hardened; and at the close £11 7s. 6d. per ton was the quotation. The average price for the year was £11 5s. per ton f.o.b. Hull; and, having regard to all the factors in the case—to stocks in producers' hands at the outset, to shrinkage in Japanese demand over the spring months, to increased output, and to the competition of cheap nitrate of soda in the second half of the year—the authors cannot say that, in their opinion, a higher average price was justified, though in the interests of producers they would have been pleased to see a better result. British producers have all along met demand freely; and in this they have done well. A temporary advantage can, of course, be created by withholding supplies. But the inevitable reaction has to be faced; and experience shows that it does not pay to keep back supplies when production is increasing substantially, as was the case in the past year.

Production in Germany during the first half of 1909 was less than in the corresponding period of 1908, when carbonizing was at high pressure. But it was on an increasing scale almost from the outset; and the total output for the year is estimated at 340,000 tons, against 313,000 tons in 1908, and 287,000 tons in 1907. Production in Belgium

during 1909 was about 35,000 tons, against 30,000 tons in 1908; while that in France was about 54,000 tons—there having been some increase from carbonizing works in the North. There was no doubt an increase in Austria and in other countries in Europe; but as no figures are forthcoming, the extent of it must remain a matter of conjecture. The output in the United States reached 100,000 tons;-and it is still rapidly increasing. The world's production is now about a million tons per annum. Messrs. Bradbury and Hirsch are careful to mention that the figures do not represent the quantity of sulphate actually made, but the ammonia calculated into terms of sulphate. Some increase in production in the United Kingdom was counted upon in the early months of last year, and a larger one later from carbonizing works; the process of reconstruction of ovens being actively pushed forward. This view proved to be correct; and within the year there was a very substantial increase in the output. Owing to depression in the industrial world, protracted strikes, and other circumstances, the output of sulphate of ammonia from gas-works in 1908 was barely on the level of that in 1907. The condition of our industries still leaves much to be desired; but, notwithstanding the short time being worked in the cotton-mills, there was, on the whole, last year a decided improvement upon 1908, and a corresponding increase in the output from gas-works. There was also an increase from shale; and the output from producer gas continues to make headway. From blast-furnaces, however, production remains without material alteration from year to year. The production of ammonia, therefore, calculated into sulphate (including that used in the manufacture of ammonia soda and for other chemical purposes), from all sources in the United Kingdom in 1909 is estimated at 348,000 tons, apportioned as follows:—

	Tons.
Gas-works	171,000
Iron ,,	19,000
Shale ,,	57,000
Coke and carbonizing works and producer gas	101,000
	348,000

Of this production, the authors reckon that England contributed 233,300 tons; Scotland, 112,000 tons; and Ireland, 2700 tons. The production (in tons) during the previous five years was as follows:—

	1908.	1907.	1906.	1905.	1904.
Gas-works	165,000	165,500	157,000	156,000	150,000
Iron ,,	18,000	21,000	21,000	20,000	19,500
Shale ,,	53,500	51,000	48,500	46,000	42,500
Coke and carbonizing and producer gas	85,000	75,500	62,500	46,500	33,500
Totals	321,500	313,000	289,000	268,500	245,500

Messrs. Bradbury and Hirsch's estimates of production in 1908 from carbonizing works and from producer gas were under the mark; but those of the output from other sources were very close. They probably under-estimated home consumption to some extent, as also stocks left in the hands of producers. Assuming that the latter amounted to 16,000 tons, the account for 1909 will stand as follows, if their estimates of production are correct:—

	Tons.
Stocks brought forward from 1908	16,000
Production during 1909	348,000
	364,000
Exports during 1909	264,000
Home consumption (for all purposes) in 1909	87,000
Stock to carry forward into 1910	13,000
	364,000

Reviewing the position generally, Messrs. Bradbury and Hirsch say: With regard to German producers, it has to be said that although they left their market fairly open up to last September they have since taken good care of it, so that shipments from the United Kingdom to German ports have been on a reduced scale compared with those for October to December, 1908. Altogether, shipments to the Continent, including Holland, from July to December, have shrunk 16,997 tons, compared with those for July to December, 1908. It may be that cheap nitrate of soda has had something to do with the much reduced demand upon the United Kingdom for sulphate of ammonia for France; but this only partly explains it. Certain it is that Germany has again appeared in the Spanish and other markets, and she has no doubt been busy in France. It is also obvious that the German selling policy is going to be more on the lines followed during the first half of 1908; and British producers would do well to make up their minds to this. Then the total German production in 1909 proves that the output must have been largely increased during the second half of the year, and justifies the opinion that fairly large stocks must be carried by producers at the present time. Moreover, production on the larger scale must be looked for over the next six and following months. A liberal selling policy on the part of German producers is therefore only common-sense policy; and Germany must be looked for in all the foreign markets which she so successfully invaded two years ago.

Turning to the United Kingdom, the authors make the following remarks: While short time continues to be worked in the cotton-mills there cannot be any great expansion in the output of sulphate of ammonia from gas-works, though the greater activity in other industries assures some increase. From fresh installations in view, it seems probable that the output from carbonizing works may be increased 10,000 or 12,000 tons within the year; and, having regard to greater capacity within the past twelve months, there is bound to be a larger supply from this source than there was over the spring months in 1909. A normal increase may be expected from shale; but not much from other sources. If, then, a substantial increase in the British as well as in the German output over the next six months is assured, what are the chances of the market in view of it, and in view of the abundant supply and low price of nitrate of soda?

Without entering into the question as to whether the unit of nitrogen in sulphate of ammonia and that in nitrate of soda are equal in value to the agriculturist, we may be permitted to point out that since 1900 they have never had anything like the same market value, and that, notwithstanding the present low price of nitrate of soda, the market value of the unit of nitrogen in sulphate of ammonia is still something like 9d. less than the market value of the unit in nitrate of soda. It would seem, therefore, that for all purposes, or for most purposes, the unit value in the two articles, as determined by present knowledge and up-to-date experience, is not equal. The important practical question is, however, whether the dearness of sulphate of ammonia in relation to nitrate of soda at the present time compared with the relative market prices of the two articles over last spring will cause any important reversion to the use of nitrate of soda over the coming season. Manifestly there will not be so great an inducement to use sulphate of ammonia as there was during the first six months of 1909; but beyond this the question does not admit of a simple and general answer—there being other things to take account of, such as climate, soil, and crops, and even prejudice. . . . We think that, notwithstanding abundant and cheap nitrate of soda and the increased output of sulphate of ammonia in the United Kingdom and in Germany, the demand for sulphate will be sufficient to absorb the supply over the coming spring months at the present level of prices. But we also think that supply and demand will be too nearly balanced to make it safe and prudent for producers to attempt to force an advance.

The "Review" concludes with the usual record of the course of the market month by month; and this is followed by the customary tabulated statistics. The first table contains the comparative weekly prices of sulphate of ammonia and nitrate of soda last year. In the week ending Jan. 2, sulphate was £11 6s. 3d., and nitrate £9 10s. per ton; on April 3, the prices were £11 10s. and £10 7s. 6d.; at Midsummer, they were £11 2s. 6d. and £10 5s.; at Michaelmas, they were £11 6s. 3d. and £9 10s.; while at the close of the year, they were £11 7s. 6d. and £9 5s. respectively. The second table shows the average prices per cwt. of 95 per cent. nitrate of soda, in Liverpool, for the past ten years. They are as follows: 1900, 8s. 5¾d.; 1901, 8s. 11½d.; 1902, 9s. 4d.; 1903, 9s. 6½d.; 1904, 10s. 2½d.; 1905, 10s. 9½d.; 1906, 11s. 4d.; 1907, 11s. 2d.; 1908, 10s. 2½d.; and 1909, 9s. 9d. The third table gives the average prices per ton of good grey (24 per cent.) sulphate f.o.b. Hull; the figures ranging over 43 years—1867 to 1909. The following are the averages for the past ten years: 1900, £11 2s.; 1901, £10 11s. 4d.; 1902, £11 16s. 3d.; 1903, £12 9s. 2d.; 1904, £12 3s. 8d.; 1905, £12 10s. 9d.; 1906, £12 0s. 9d; 1907, £11 15s. 8d.; 1908, £11 12s.; and 1909, £11 5s.

NOTES FROM SCOTLAND.

From Our Own Correspondent.

Saturday.

At the meeting of the Eastern District of the Scottish Junior Gas Association at Perth this afternoon, the author of the paper which was read—Mr. S. Butter, of Perth—led the members upon an excursion into one of the many side avenues in the path of the gas industry. His subject was "Tar as a Preservative"—a subject quite limited in itself, but which he chose to limit still further, by confining his attention to the effect of tar, applied under pressure, in the preservation of road surfaces. Mr. Butter acted with great wisdom in doing this. The tendency is for authors to write a treatise upon their subject, and not a paper bringing out points which are new, and which they wish to emphasize. The result too often is that discussions go rambling about upon a number of topics, and the main point is in danger of being, and sometimes is, lost sight of. If the members of the Junior Gas Association concur in the view that example is better than precept, and apply this doctrine to their own course, they will surely follow Mr. Butter's example; for in the proceedings that followed the reading of his communication there was ample justification for the view that a single-barrelled paper is more profitable than, and is to be preferred to, one in which too wide a field is endeavoured to be covered. The speaking was all by junior members of the Association, with the exception that Mr. W. B. M'Lusky, an honorary member, wound it up with a few well-chosen thoughts. Mr. M'Lusky refrained from speaking until the juniors had said what they had to say; and in this he is to be commended, because there are not many juniors who care to rise in a meeting and express opinions which may run counter to those already announced by a senior. The Association are to be congratulated upon the success of their meeting at Perth, which, it may be said, was held under the most inauspicious circumstances—the day being very wet; but, as I have observed before, in connection with the meetings which are held outside of Edinburgh, there was a great dearth of members coming from that city. So far as I could ascertain, there was but one Edinburgh gentleman present; and there were only two altogether from south of the Forth. This state of matters is to be regretted, as much for the sake of the members themselves (who are losing the benefit of association) as for the sake of the Association, which loses the benefit of the talents that are absent. When the quarterly meetings are held in Edinburgh, there is always a strong representation of the membership north of the Forth; and in this matter it would be pleasant to see a spirit of reciprocity prevailing.

The plebiscite of ratepayers in Kirkcaldy as to the transfer of the gas undertaking to the Corporation was taken on Wednesday. The resolution of the Town Council to acquire the concern was agreed to all but unanimously; Mr. Mackinnon being the only member who dissented. He and his supporters, after the Council had resolved to proceed with the transfer, held a series of meetings in the town, with a view to creating an adverse agitation. Mr. Mackinnon was himself the principal speaker at these meetings. Following upon this, the members of the Council who supported the transfer held meetings in the respective wards in the town, at which reasons for the transfer were placed before the electorate. Polling took place all day on Wednesday. There were 7884 electors on the roll. Out of these, there were 4881 who did not record their votes; leaving 3003 who did. The result of the poll was: For, 2281; against, 735—a majority in favour of the transfer of 1546. There were nine spoiled papers. After the result was announced, Mr. J. Wright proposed a hearty vote of thanks to Bailie Peebles, who had acted as Polling Sheriff. As Convener of the Committee on the gas

transfer, he expressed, on behalf of the Council, their thanks to the staff for their labours that day.

In the "Glasgow Herald" of Thursday, there appeared the following statement: "Mr. Wm. Wilson, Gas Manager, Falkirk, who was formerly Gas Manager at Kirkintilloch, has made a claim against the Town Council of Kirkintilloch for a considerable sum as a percentage on the cost of the new gas-works at Kirkintilloch, built under his superintendence and to plans of his preparation. The Council have unanimously resolved to repudiate the claim." Without entering into the merits of the claim, as to which I know nothing except what is contained in the above announcement, I may recall that Mr. Wilson left Kirkintilloch for Falkirk in February, 1907, about the time the erection of the new gas-works was begun. His successor—Mr. J. M'Leod, of Provan—saw the works opened in June, 1908, and not very long afterwards—in November of the same year—he was appointed Gas Manager at Greenock, in succession to Mr. W. Ewing. What I wish to call attention to is that in less than three years Mr. M'Leod has had the good fortune to hold two appointments as Gas Manager, and that in both of them his predecessor has seen fit to make a claim upon the Corporation.

In the Hamilton Town Council on Tuesday, the Gas Committee reported that the Convener had been waited upon by two gentlemen representing a large number of inhabitants in the Eddlewood and Meikle Earnock districts who desire a supply of gas; and that after hearing a report from the Gas Manager regarding a proposed scheme for lighting the Eddlewood district, the Committee unanimously agreed to proceed with the scheme, and remitted to the Manager to make arrangements with the County District Committee for the opening of the roads. At a subsequent meeting of the Committee, however, there was submitted a petition, signed by 18 owners and occupiers in Meikle Earnock, requesting a supply of gas. As this number was less than had been stated at a previous meeting, it was resolved to delay proceeding with the scheme until fuller information should be laid before them as to the probable demand for gas. The Town Council agreed to this course being followed.

At a special meeting of the Fraserburgh Town Council on Monday, it was unanimously resolved, on the motion of Mr. G. Low, that the Burghs Gas Supply (Scotland) Act should be adopted, and the existing gas-works of the Fraserburgh Gaslight Company, Limited, acquired. The Town Clerk was instructed to take the necessary steps to carry through the provisions of the Act. A plebiscite of the ratepayers will be taken next month.

Yesterday, the formal ceremony of turning on the water at the new reservoir at Glenquey was performed by Mr. David Alexander, the Chairman of the Dunfermline District Committee. As is well known, the works are intended to give a supply of water to practically the whole of the district of West Fife, with the exception of Dunfermline and Cowdenbeath. They are to provide a supply also, under agreement with the Admiralty, for Rosyth. It is also matter of common knowledge that the works have been long delayed owing to exceptional and unforeseen engineering difficulties having arisen after the works were begun, and that the same cause has been the means of more than doubling their cost. The main pipe is able to provide a supply of 3 million gallons every 24 hours. After the water had been turned on, luncheon was served in the Rumbling Bridge Hotel. Mr. Alexander, who has been Chairman of the District Committee for 16 years, was presented with a rose bowl and silver salver, in recognition of his long and arduous services to the Committee. In the course of his remarks in acknowledgment of the gifts, Mr. Alexander said that the first estimated cost of the works was £91,500; and, so far as he could see, the total cost would now be £195,000. In carrying out the works, they had provided, and he thought wisely, for the future. The embankment of the reservoir had been so made that it would stand to be raised by another 11 feet; so that in place of containing 260 million gallons as at present, it would have a storage capacity of 370 million gallons. Mr. J. D. Parker, of Glasgow, was Engineer to the scheme.

CURRENT SALES OF GAS PRODUCTS.

Sulphate of Ammonia. LIVERPOOL, *Jan.* 15.

There has been an abundant supply; but it has all been eagerly sought after at continually hardening prices. Demand has not only been for the purpose of covering sales made by dealers in advance, but new orders direct from consumers have also been fairly plentiful. The market closes at the highest point reached; and the nearest values are £11 11s. 3d. per ton f.o.b. Hull, £11 13s. 9d. per ton f.o.b. Liverpool, and £11 15s. per ton f.o.b. Leith. In the forward position, there are sellers over the next few months at prompt prices; but buyers remain quite apathetic, evidently preferring to wait till later on in the hope of then purchasing at less money.

Nitrate of Soda.

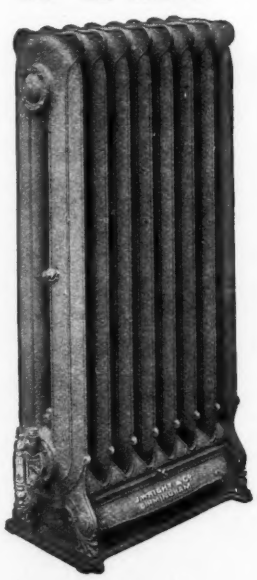
This article is rather easier again, and spot quotations have been reduced to 9s. 1½d. per cwt. and 9s. 4½d. for ordinary and refined qualities respectively.

Tar Products. LONDON, *Jan.* 17.

Markets for tar products have been firm throughout the past week, though there has not been really any further advance in price. The market, however, is in a very healthy condition; and though it seems to be impossible yet to interest the Belgians, in certain parts of France consumers are certainly buying. In South Wales, there is not very much business to be done, as consumers appear disinclined to buy until they have obtained their fuel orders. In creosote, the market is steady all round, and it is still generally believed that an improvement will take place in a month or two. Benzol, 90 per cent., is very firm

THE "St. Andrew"!

The "St. Andrew."



WE seldom advertise any single order,
WE are constantly receiving large orders,
WE are constantly receiving repeat orders,

In Fact,

Wherever the HIGHEST QUALITY,
Wherever SUPREME SCIENTIFIC ACCURACY,
Wherever PERFECT ECONOMY are appreciated, as distinguished from

Mere cheapness joined to unscientific construction, the apparatus specified is invariably

The "ST. ANDREW."

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Essex Works, BIRMINGHAM.

for prompt delivery; while for forward, makers are not at all inclined to sell except at good figures. Fifty-ninety per cent. benzol is firm; while the demand for toluol is good, especially in the North. Solvent naphtha remains very steady, though it is reported that the Germans are selling on the Continent at low figures. Heavy naphtha is quiet. Carbolic acid is a little firmer; but consumers are still unwilling to pay any advance. Creosote salts remain very firm.

The average values during the week were: Tar, 14s. 6d. to 18s. 6d., *ex* works. Pitch, London, 30s. to 30s. 6d.; east coast, 29s. to 29s. 6d.; west coast, 29s. to 30s. f.a.s., 29s. f.o.b. Benzol, 90 per cent., casks included, London, 6⅞d. to 7d.; North, 6d. to 6¼d.; 50-90 per cent., casks included, London, 7⅜d.; North, 6⅞d. to 7d. Toluol, casks included, London, 9⅜d. to 10d.; North, 9¼d. Crude naphtha, in bulk, London, 4d. to 4¼d.; North, 3⅞d. to 4⅛d.; solvent naphtha, casks included, London, 1s. 1½d. to 1s. 2d.; North, 1s. 0½d. to 1s. 1⅛d.; heavy naphtha, casks included, London, 11⅜d.; North, 10⅜d. to 11d. Creosote, in bulk, London, 2⅛d. to 2⅝d.; North, 2d. to 2⅛d. Heavy oils, in bulk, 2⅛d. Carbolic acid, 60 per cent., casks included, east coast, 10⅜d. to 11½d.; west coast, 11d. to 11½d. Refined naphthalene, £4 10s. to £8 10s.; salts, 40s. to 42s. 6d., packages included and f.o.b. Anthracene, "A" quality, 1⅛d. to 1¾d. per unit, packages included and delivered.

Sulphate of Ammonia.

The market has been steady during the past week; and for prompt delivery there is an exceedingly good demand. In London, the principal Gas Companies quote £11 15s. for January-June delivery; but outside makes are selling for prompt delivery at about £11 6s. 3d. In Hull, £11 10s. to £11 12s. 6d. is the quotation. In Liverpool, £11 15s. is reported to have been paid, and the same figure in Leith; while in Middlesbrough also £11 15s. is obtainable for forward delivery.

Proposed Extension of Barnstaple Water-Works.—A meeting of the shareholders of the Barnstaple Water Company was held yesterday week, for the purpose of authorizing the Directors to proceed with the application for a Provisional Order to extend the area of supply to Instow. Mr. C. E. R. Chanter, the Chairman, explained that the area did not at present extend beyond Fremington. The Company possessed a very large quantity of water; and since safeguards would be provided against supplying it at a loss, it was desirable they should not keep the water to themselves. In any case, the question of supplying Bickington and Fremington would have to be faced. If the work were carried out, it would be necessary to lay mains from the high level; and on the way to Instow these mains would pass through Bickington and Fremington, the inhabitants of which could be supplied. The Rural District Council would give a guarantee of 10 per cent. on the outlay, as for a few years the water-rate would probably not yield this amount. He moved that a Provisional Order be applied for; and this was carried.

COAL TRADE REPORTS.

Northern Coal Trade.

There has been some slight increase in the output of coal at the north-eastern collieries, but it is not up to the average. Still the high prices of a week ago are now to some extent reduced. In the steam coal trade, coal appears to be more plentiful; and thus for best Northumbrian steams, the quotation is now from 11s. 3d. to 11s. 6d. per ton f.o.b., with second-class steams and steam smalls at comparative prices. The work at the steam coal collieries seems to be fuller on the part of the miners, and the outlook is more hopeful than it is for the Durham collieries at the time of writing. In the county of Durham, the output is more reduced, and there are some classes of fuel that are more scarce, while the prospect is a little more doubtful. It is difficult to quote prices; but best gas coals are somewhere near 12s. per ton f.o.b. where delivery can be readily given. One or two contracts are in the market, but not for large quantities; and neither buyers nor sellers are very eager to contract until the production is more settled in prospect. It is hoped, however, that the next few days will see a change for the better in this respect. Coke is firm and scarce. Gas coke is more in demand at from 13s. 6d. to 14s. per ton f.o.b. in the Tyne.

Scotch Coal Trade.

The first report for the year is that trade has opened under quite favourable conditions; there being a healthy demand for all descriptions of fuel, and prices having an upward tendency, particularly for ell coal. The prices now quoted are: Ell, 10s. 3d. to 10s. 9d. per ton f.o.b. Glasgow; splint, 10s. 6d. to 11s.; and steam, 10s. 3d. to 10s. 9d. The shipments for the week amounted to 143,870 tons—a decrease of 100,753 tons upon the preceding week, but an increase of 11,945 tons upon the corresponding week of last year.

Power-Gas Corporation, Limited.—The Directors, in their report for the year ended Sept. 30 last, state that the works of Messrs. Ashmore, Benson, Pease, and Co., Limited, have been maintained in a condition of efficiency and repair, and all expenditure for this purpose has been charged to revenue. After placing £1800 to a fund for renewals and contingencies, the year's trading of the Company named shows a profit of £2777, which has been carried forward to their next account. The results of the year's trading of the Power-Gas Corporation show a total profit of £3799, to which has been added just over £2660 brought forward from the previous year's account; making altogether £6440. This sum the Directors propose to deal with as follows: Creation of a reserve, in terms of Article 3, £750; balance to be carried forward to next account, £5690. The Directors state that the works were fairly well employed during the year, and continue so at the present time.

Richmond's Gas Flasher.

A Gas Manager, when sending an order for a Gas Flasher, mentions "it is urgently wanted

FOR POLITICAL PURPOSES"

¶ We suggest that your Electioneering Agents are looked up. It is an opportunity to exploit GAS in the way of illuminating a SIGN which "talks" Day and Night. Simply a locally made Glass Frame, with necessary wording on the Glass, suspended in front of Two or Three Incandescent Burners (controlled by a Richmond Gas Flasher), will make an effective Electioneering Device; or, if desired, we can supply sign complete, any size, any shape, any wording.

THE RICHMOND GAS STOVE & METER CO., LTD.

Advertisement of the RICHMOND GAS STOVE & METER CO., LTD.
London Offices and Show-Rooms: 132, Queen Victoria Street, E.C. General Offices and Works: Warrington.

Proposed Gas-Works for Llanwrtyd.—At a recent meeting of the Llanwrtyd Wells Urban District Council, a letter was received from Mr. R. D. Edmunds (Llanelly), informing the Council that Messrs. Willey and Co., Limited, had secured a plot of land with a view to building gas-works at Llanwrtyd Wells, and asking the Council's permission to lay mains. The Council resolved to approve of the proposal, and referred the provisional agreement to the General Purposes Committee.

Longton and the Staffordshire Potteries Water Bill.—In connection with the proposal of the Staffordshire Potteries Water Company to promote a Bill in the ensuing session for an additional extension of their system, the Longton Town Council have passed a resolution to the effect that, in view of the pending federation of the Potteries towns, it is desirable that the local authorities in the district should unitedly take the above matter into consideration; and that it should be suggested to the other local authorities that a joint conference should be held to consider the subject.

German Welsbach Company.—The report of the German Incandescent (Auer) Gaslight Company for the year 1908-09 states that the net profit, including a sum of 510,080 marks brought forward, amounts to 4,038,199 marks (about £198,000), which, after writing off 375,000 marks, admits of the payment of a dividend of 50 per cent. on the founders' shares (against 35 per cent. the year before). The preference shareholders receive 5 per cent. on the amount (30 per cent.) paid up of the nominal preference capital, and a special dividend of 6 per cent. on this nominal capital sum. The prospects of the current year's working are regarded as favourable.

Clevedon Water Purchase Question.—A meeting called by the Urban District Council was held at the Public Hall, Clevedon, a few days ago, in connection with the proposed purchase by the town of the water-works, at a cost of £58,000. The case for the purchase was put by Mr. A. E. Y. Trestrail (Solicitor); and afterwards speeches in opposition were made by a number of gentlemen. Councillor Lee proposed, and Councillor Taylor seconded, a resolution in favour of the purchase; and, on account of the late hour, Councillor Brett moved that the meeting be adjourned. This was defeated by cries of "Vote;" and ultimately, by an overwhelming majority, the meeting decided not to favour the purchase.

Fatal Gas Explosion in the City.—Soon after eight o'clock on Saturday morning, an explosion took place at 58, Coleman Street, E.C., on premises tenanted by Messrs. Jackson, Pixley, and Co., chartered accountants. A painter named Lloyd, who, it is stated, had been warned by the caretaker that there was a smell of gas, went down to the basement to get his paints. A few seconds afterwards there was a violent explosion, which shattered the cellar walls, blew out the pavement lights, demolished most of the fittings on the ground floor, and threw a postman, who was standing on the doorstep at the time, into the road. Several windows of neighbouring houses were broken. On the arrival of the Fire Brigade, almost immediately afterwards, Lloyd was found dead, pinned down under a mass of brickwork.

Prepayment Supplies and Gas-Stoves.—At the monthly meeting of the Burton Town Council, Alderman Lowe moved the adoption of a recommendation of the Gas Committee that the tender of the Richmond Gas Stove and Meter Company be accepted for a further 1000 gas-stoves for use in connection with prepayment installations. He remarked that they were exactly the same as those which had been supplied before. The Council would observe with satisfaction that the amount of gas consumed and sold during last month showed a considerable increase compared with the corresponding period last year. He hoped this would continue. They could not help thinking that they had been assisted a good deal by the supply of stoves to prepayment consumers. The recommendation was adopted. In this connection, it may be remarked that in 300 instances where the actual consumptions of prepayment consumers with stoves were compared with the corresponding consumptions before the stove was fixed, an increase of 60 per cent. was found.

Opposition to the Exmouth Water Bill.—As was the case last year, the opponents of the Exmouth Water Bill are sparing no effort to impress their views on the minds of the inhabitants. Following the statutory meeting of ratepayers, at which it was decided to proceed with the Bill, they called another public meeting, at which the case against the District Council's scheme was explained at length. Mr. J. Carter contended that the reason for the shortness of water was that the bogs which formed the natural reservoir of the present supply had been cut through, and the water allowed to drain into the sea instead of being preserved for dry seasons. He was also of opinion that if the pipe-line were extended at the intakes they would get all the water they needed, and the cost would not be more than £400 or £500. Mr. Beavis, who was Manager of the water-works before they were taken over by the Council, also spoke in opposition to the scheme, and contended that there were other methods of obtaining the water required at less cost. A resolution against the Council's proposal was unanimously passed. A poll on the question has been demanded, and will take place.

The question of the purchase of the local gas undertaking has been raised in the Penistone Urban District Council; but as only half the members happened to be present, it was arranged to call a special meeting for the discussion of the matter. This will be held next Tuesday.

Mr. A. W. Brightmore, of the Local Government Board, held an inquiry at Faringdon, last Thursday week, with reference to the sanctioning of a further loan (to be secured on the rates of Faringdon) to cover the cost of construction of the new supplementary water supply. The proceedings did not excite much outside interest; the attendance being principally confined to members and officials of the Rural District Council. Mr. Margetts, the Engineer of the works, and the Medical Officer of Health were among those who afforded information to the representative of the Board; while Mr. G. Adams, a resident, urged the unfairness which would arise if the area of rateability embraced parts of the parish outside the town.

PARKINSON

GAS-HEATED

Steam Radiators

ARE

UNEXCELLED

FOR THE

Efficient and Economical Heating of

CHURCHES, SCHOOLS,
PUBLIC BUILDINGS,
SKATING RINKS,
SHOPS, &c., &c.

EXTRACT FROM LETTER JUST RECEIVED:—

"The Radiators which I fixed in the Wesleyan Chapel and Schools are giving the **greatest satisfaction.** Any inquiries you have refer to me, and I will refer them to the Chapel Committee, from whom they will get the **greatest praise.** They are at present recommending them to the Baptist Church. . . Other Radiators in the town fixed in offices, &c., are **all** giving satisfaction."

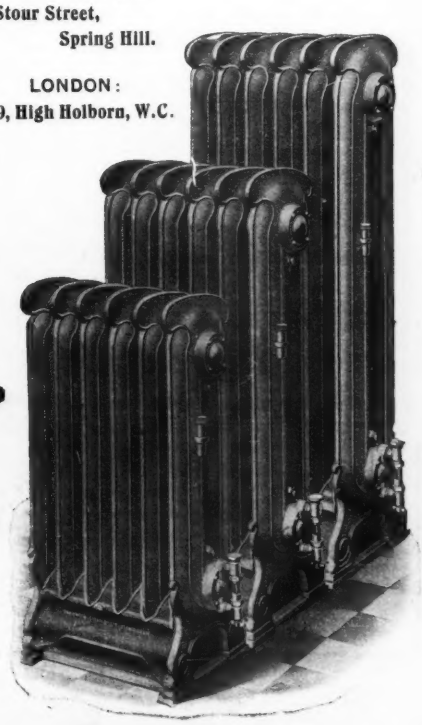
YOUR INQUIRIES WILL BE ESTEEMED.

THE PARKINSON STOVE CO., LTD.

(Incorporating Maughan's Patent Geyser Co.)

BIRMINGHAM:
Stour Street,
Spring Hill.

LONDON:
129, High Holborn, W.C.



The Parkinson Stove Company, Limited, of Birmingham, have forwarded to us one of their presentation inkstands, which takes the form of an attractive looking little model of a gas-fire.

At a meeting of the Wolverhampton Town Council on Monday last week, the Water Committee recommended the acceptance of the tender of Mr. Holloway, of Wolverhampton, for providing and laying a 24-inch pumping main at £17,764 2s. Alderman Marston, the Chairman of the Committee, said there were 31 tenders adjudicated upon. Mr. Holloway's was not the lowest, but the Committee thought it was the best. The highest tender for a similar specification was £26,162.

As indicating the briskness of their trade just now, the Bland Light Syndicate, Limited, send a newspaper cutting of a Police Court case in which one of their men was recently involved. He was summoned for causing 42 packing cases to remain in the carriageway of Little Trinity Lane for a longer time than was required for loading or unloading. Defendant said they were very busy with export orders, and the cases were left there longer than usual. He was, notwithstanding, fined 20s., and costs. The Syndicate have declared an interim dividend at the rate of 10 per cent. per annum for the six months ending Nov. 30 last.

WANTED, FOR SALE, CONTRACT, &c., ADVERTISEMENTS IN THIS WEEK'S "JOURNAL."

Situations Vacant.

ASSISTANT-ENGINEER (New Zealand). No. 5172.
ENGINEER AND MANAGER. Beccles Water and Gas Company. Applications by Feb. 1.
GENERAL MANAGER (Commercial Company). S.R., c/o Streets, Cornhill.
WORKS' DIRECTOR (To take up shares). No. 5171.

Situations Wanted.

DRAUGHTSMAN. Barker, Ilford.
ENGINEER'S ASSISTANT. No. 5173.
SECRETARY, MANAGER, OR ACCOUNTANT. No. 5115.

Plant, &c., for Sale.

WASHER-SCRUBBER. Mansfield Gas-Works.

Meeting.

SOUTH METROPOLITAN GAS COMPANY. De Keyser's Hotel, Feb. 9, Two o'clock.

TENDERS FOR

Coal.

LEIGH-ON-SEA GAS DEPARTMENT. Tenders by Jan. 27.

Coke.

ASHFORD URBAN DISTRICT COUNCIL. Tenders by Jan. 28.

Fire-Clay Goods, &c.

EAST RETFORD GAS DEPARTMENT. Tenders by Feb. 3.

Gas Oil.

ASHFORD URBAN DISTRICT COUNCIL. Tenders by Jan. 28.

Iron Work for Retort Bench.

SHEFFIELD UNITED GAS COMPANY. Tenders by Feb. 8.

Mantles.

OSSETT CORPORATION. Tenders by Jan. 28.

Retort Bench, &c. (Dismantling Old and Rebuilding New Complete).

EAST RETFORD GAS DEPARTMENT. Tenders by Feb. 3.

NOTICES TO CORRESPONDENTS, ADVERTISERS, AND SUBSCRIBERS.

No notice can be taken of anonymous communications. Whatever is intended for insertion in the "JOURNAL" must be authenticated by the name and address of the writer; not necessarily for publication, but as a proof of good faith.

Subscribers who desire to avail themselves of the reduction in the Subscription by paying in advance for the Year 1910, are reminded that this can only be done during the present month.

Orders for Alterations in, or stoppages of, PERMANENT ADVERTISEMENTS should be received by the FIRST POST on SATURDAY.

Wanted, For Sale, and Tender Advertisements, Six Lines and under, 3s.; each additional Line, 6d.

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GAS COMPANIES' STOCK AND SHARE LIST.

Referred to on p. 151.

Issue	Share.	When ex-Dividend.	Dividend or Dividend & Bonus.	NAME.	Closing Prices.	Rise or Fall in Wk.	Yield upon Investment.
£			p.c.				£ s. d.
1,474,000	Stk.	Oct. 14	5	Alliance & Dublin Ord.	85–87	..	5 14 11
310,000	Stk.	Jan. 13	4	Do. 4 p.c. Deb.	98–100*	..	4 0 0
200,000	5	Oct. 28	6½	Bombay, Ltd.	5⅞–6⅛	+⅛	5 6 1
40,000	5	,,	6½	Do. New, £4 paid	4⅞–4⅝	..	5 6 8
50,000	10	Aug. 26	15	Bourne-	28⅛–29	..	5 3 5
311,810	10	,,	7	mouth Gas, B 7 p.c.	16⅛–16⅜	..	4 3 7
75,000	10	,,	6	and Water, Pref. 6 p.c.	15⅛–15⅜	..	3 16 2
380,000	Stk.	Aug. 12	12½	Brentford Consolidated	253–256	..	4 17 8
300,000	,,	,,	9½	Do. New	190–192	+1	4 19 0
50,000	,,	,,	5	Do. 5 p.c. Pref.	120–122	..	4 2 0
206,250	,,	Dec. 29	4	Do. 4 p.c. Deb.	99–101	..	3 19 3
220,000	Stk.	Sep. 10	11	Brighton & Hove Orig.	217–220	..	5 0 0
246,320	,,	,,	8	Do. A Ord. Stk.	154–157	..	5 1 1
460,000	20	Oct. 14	10	British	42½–43½	..	4 11 11
109,000	Stk.	Aug. 26	6	Bromley, A 5 p.c.	118–120	..	5 0 0
165,700	,,	,,	4½	Do. B 3½ p.c.	88–90	..	5 0 0
82,278	,,	,	5½	Do. C 5 p.c.	106–108	..	5 1 10
55,000	,,	Dec. 29	3½	Do. 3½ p.c. Deb.	87–89	..	3 18 8
500,000	10	Oct. 14	7	Buenos Ayres (New) Ltd.	14–14½	..	4 16 7
250,000	Stk.	Dec. 29	4	Do. 4 p.c. Deb.	98–100	..	4 0 0
100,000	10	—	—	Cape Town & Dis., Ltd.	3–4	..	—
100,000	10	—	—	Do. 4½ p.c. Pref.	5⅛–5⅜	..	—
50,000	50	Nov. 2	6	Do. 6 p.c. 1st Mort.	48–49	..	6 2 6
100,000	Stk.	Dec. 29	4½	Do. 4½ p.c. Deb. Stk.	80–82	..	5 9 9
157,150	Stk.	Aug. 12	5	Chester 5 p.c. Ord.	108½–110½	..	4 10 6
1,493,280	Stk.	Aug. 26	5⅝	Commercial 4 p.c. Stk.	109–111	..	4 13 8
560,000	,,	,,	5	Do. 3½ p.c. do.	103–105	..	4 15 3
475,000	,,	Dec. 29	3	Do. 3 p.c. Deb. Stk.	81–83	..	3 12 3
800 000	Stk.	Dec. 10	5	Continental Union, Ltd.	95–97	..	5 3 1
200,000	,,	,,	7	Do. 7 p.c. Pref.	137–139	..	5 0 9
492,270	Stk.	—	5	Derby Con. Stk.	121–123	..	4 1 4
55,000	,,	—	4	Do. Deb. Stk.	103–105	..	3 16 2
148,995	,,	Oct. 2	5	East Hull 5 p.c. Ord.	98–100	..	5 0 0
486,090	10	July 14	12	European, Ltd.	24½–25	..	4 16 0
354,060	10	,,	12	Do. £7 10s. paid.	18½–19	..	4 14 9
15,141,345	Stk.	Aug. 12	4⅝	Gas, 4 p.c. Ord.	103¾–104⅝	+¼	4 9 1
2,600,000	,,	,,	3½	light, 3½ p.c. max.	87–89	..	3 18 8
3,799,735	,,	,,	4	and, 4 p.c. Con. Pref.	103–105	..	3 16 2
4,193,975	,,	Dec. 29	3	Coke, 3 p.c. Con. Deb.	81–83	..	3 12 3
258,740	Stk.	Sep. 10	5	Hastings & St. L. 3½ p.c.	94–96	..	5 4 2
82,500	,,	,,	6½	Do. do. 5 p.c.	118–120	..	5 8 4
70,000	10	Sep. 29	11	Hongkong & China, Ltd.	17½–18	..	6 2 3
131,070	Stk.	Sep. 10	6½	Ilford A and C	144–146	..	4 9 0
65,789	,,	,,	5	Do. B	108–110	..	4 10 11
65,500	,,	Dec. 29	4	Do. 4 p.c. Deb.	100–102	..	3 18 5

Issue	Share.	When Dividend.	Dividend or Dividend & Bonus.	NAME.	Closing Prices.	Rise or Fall in Wk.	Yield upon Investment.
£			p.c.				£ s. d.
4,940,000	Stk.	Nov. 11	8	Imperial Continental	175–177	..	4 10 5
1,235,000	Stk.	Aug. 12	3½	Do. 3½ p.c. Deb. Red.	94–96	..	3 12 11
195,242	Stk.	Aug. 26	6	Lea Bridge Ord. 5 p.c.	119–121	..	4 19 2
561,000	Stk.	,,	10	Liverpool United A	227–229	+4	4 7 4
718,100	,,	,,	7	Do. B	16⅜–16⅝	+1	4 2 10
306,083	,,	Dec. 29	4	Do. Deb. Stk.	103–105	+1	3 16 2
75,000	5	Nov. 26	6	Malta & Mediterranean.	4⅛–5	..	6 0 0
560,000	100	Oct. 1	5	Met. of, 5 p.c. Deb	99–102	..	4 18 0
250,000	100	,,	4½	Melbourne, 4½ p.c. Deb.	100–102	..	4 8 3
541,920	20	Nov. 11	3½	Monte Video, Ltd.	12⅛–13	..	5 7 8
1,775,892	Stk.	July 29	4½	Newc'tle & G'tesh'd Con	107–108	+⅛	4 3 4
518,795	Stk.	Dec. 29	3½	Do. 3½ p.c. Deb.	91–93	..	3 15 3
55,940	10	Aug. 26	7	North Middlesex 7 p.c.	13–13⅛	..	5 3 8
300,000	Stk.	Nov. 26	8	Oriental, Ltd.	137–139	..	5 15 1
60,000	5	Sep. 10	8	Ottoman, Ltd.	6⅛–6⅜	..	6 5 6
31,800	53	Aug. 26	13	Portsea Island A.	137–139	..	4 19 0
60,000	50	,,	13	Do. B.	129–131	..	4 19 3
100,000	50	,,	12	Do. C.	122–124	..	4 16 9
114,800	50	,,	10	Do. D and E.	102–104	..	4 16 2
398,490	5	Oct. 28	7	Primitiva Ord.	7⅛–7⅜	..	4 14 11
796,980	5	July 29	5	Do. 5 p.c. Pref.	5⅛–5⅜	..	4 13 0
488,903	100	Dec. 1	4	Do. 4 p.c. Deb.	97–99	..	4 0 10
1,000,000	10	Oct. 14	8	River Plate Ord.	17–17⅛	..	4 11 5
312,650	Stk.	Dec. 29	4	Do. 4 p.c. Deb.	98–100	..	4 0 0
250,000	10	Sep. 29	8	San Paulo, Ltd.	14⅜–15	..	5 6 8
62,500	10	,,	6	Do. 6 p.c. Pref.	11⅞–12⅛	..	4 18 0
125,000	50	Jan. 3	5	Do. 5 p.c. Deb.	50–51	..	4 18 0
135,000	Stk.	Sep. 10	10	Sheffield A	233–235	..	4 5 1
209,984	,,	,,	10	Do. B	233–235	..	4 5 1
523,500	,,	,,	10	Do. C	233–235	..	4 5 1
70,000	10	Oct. 14	10	South African	12¼–12¾	..	7 16 11
6,429,895	Stk.	Aug. 12	5½	South Met., 4 p.c. Ord.	120–122	..	4 7 4
1,895,445	,,	Jan. 13	3	Do. 3 p.c. Deb.	81–83*	+⅛	3 12 3
209,820	Stk.	Aug. 26	8	South Shields Con. Stk.	160–162	..	4 18 9
605,000	Stk.	Aug. 12	5½	S'th Suburb'n Ord. 5 p.c.	120–122	..	4 10 2
60,000	,,	,,	5	Do. 5 p.c. Pref.	120–122	..	4 2 0
117,058	,,	Jan. 13	5	Do. 5 p.c. Deb. Stk.	120–122*	+⅛	4 2 0
502,310	Stk.	Nov. 11	5	Southampton Ord.	110–112	..	4 9 3
120,000	Stk.	Aug. 12	6⅞	Tottenham, A 5 p.c.	133–135	..	5 1 9
453,940	,,	,,	5⅜	and, B 3½ p.c.	111–113	..	4 15 3
149,470	,,	Dec. 29	4	Edmonton, 4 p.c. Deb.	98–100	..	4 0 0
182,380	10	Dec. 29	8	Tuscan, Ltd.	9–9½	..	8 8 6
149,900	10	Jan. 3	5	Do. 5 p.c. Deb. Red.	99–101	..	4 19 0
236,476	Stk.	Aug. 14	5	Tynemouth, 5 p.c. max.	110–112	..	4 9 3
255,636	Stk.	Aug. 26	6⅜	Wands-, B 3½ p.c.	139–141	..	4 14 0
79,416	,,	Dec. 29	3	worth, 3p.c. Deb. Stk.	72–74	..	4 1 1

Prices marked * are "Ex div."

OXIDE OF IRON.

O'NEILL'S OXIDE
For GAS PURIFICATION.
LARGEST SALE OF ANY OXIDE.

SPENT OXIDE PURCHASED IN ANY DISTRICT.

GAS PURIFICATION & CHEMICAL CO., LD.,
PALMERSTON HOUSE,
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WINKELMANN'S
"VOLCANIC" FIRE CEMENT.
Resists 4500° Fahr. Best for GAS-WORKS.
ANDREW STEPHENSON, 182, Palmerston House, Old Broad Street, London, E.C. "Volcanism, London."

LUX'S GAS PURIFYING MASS.
See Advertisement on p. 133.
FRIEDRICH LUX, LUDWIGSHAFEN-AM-RHEIN.

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F. S. Rix,
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BOROUGH OF OSSETT.
(Street Lighting Department.)

TENDERS are invited for the Supply of INCANDESCENT MANTLES for the Year ending Dec. 31, 1910.
Full Particulars and Form of Tender may be had from the undersigned.
Sealed Tenders, endorsed "Mantles," to be sent to the Town Clerk, Ossett, not later than Friday, Jan. 28.
By order,
H. G. Keywood,
Borough Surveyor.

TO ENGINEERS AND IRONFOUNDERS.

THE Directors of the Sheffield United Gaslight Company invite TENDERS for the Supply of STEEL and IRON WORK for Twelve Settings of TEN RETORTS at their Neepsend Works.

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Tender No. 3.

For the Supply and Erection of Steel and Iron Work in HYDRAULIC MAINS, ASCENSION PIPES, GAS and TAR MAINS, &c.

Drawings may be seen and Specification, with Form of Tender and Quantities obtained (on and after Jan. 24) upon Application to the Engineer, Mr. J. W. Morrison, at the Company's Offices, Commercial Street.
The Directors do not bind themselves to accept the lowest or any Tender.
Sealed Tenders, endorsed, must be delivered by post to Mr. Hanbury Thomas, Managing-Director, not later than the First Post on Tuesday, the 8th day of February.
Wm. Hamby,
Secretary.
Commercial Street,
Sheffield, Jan. 15, 1910.

ASHFORD (KENT) URBAN DISTRICT COUNCIL.

THE above Council invite Tenders for the Supply of 50,000 Gallons of GAS OIL.
They are also prepared to receive TENDERS for the available Surplus COKE (about 1000 Tons) over the ensuing year ending Jan. 31, 1911.
Endorsed sealed Tenders to be sent to the Clerk to the Council, 11, Bank Street, Ashford, Kent, on or before Nine a.m., on Friday, the 28th inst.
Further Particulars can be obtained from the undersigned, to whom a Sample of the Oil offered must be submitted.
H. R. Turner,
Engineer and Manager.
Gas-Works, Ashford,
Kent, Jan. 17, 1910.

URBAN DISTRICT COUNCIL OF LEIGH-ON-SEA.
(Gas Department.)

THE above Council invite Tenders for the Supply of 3000 Tons of Good GAS COAL to be delivered as required in quantities of about 85 Tons, at the Gas-Works Wharf, Leigh-on-Sea, during a period of Twelve Months from the 31st day of March, 1910.
Sealed Tenders, endorsed "Tender for Coal," must be received by me not later than Twelve o'clock noon on Thursday, the 27th day of January, 1910.
No Special Forms are supplied.
The Council do not bind themselves to accept the lowest or any Tender.
W. Carlyle Croasdell,
Clerk to the Council.
Council Offices, Leigh-on-Sea,
Jan. 15, 1910.

BOROUGH OF EAST RETFORD.

GAS UNDERTAKING.

THE Gas Committee of the above Cor- poration are open to receive TENDERS for the DISMANTLING and REMOVAL of an old BENCH of SIX SETTINGS of RETORTS, on the Direct-Fired System, and the REBUILDING of a Complete New Stack of SIX SETTINGS of Seven RETORTS, each with SHALLOW TUBULAR REGENERATIVE TYPE of FURNACES.
The Contract to include the Supply and Erection of all the necessary Steel and Ironwork for same, including Retort Mouthpieces, Ascension Pipes, Hydraulic Mains, Girders, Buckstaves, Valves, Furnace Fittings, Sight Boxes, Girders and Cover Plates for Subway.
The Specification may be seen, and further Particulars obtained, on personal Application to the undersigned.
Tenders to be sent in not later than Feb. 8, 1910, addressed to the Chairman of the Gas Committee, endorsed "Tender for Retort Settings."
The lowest or any Tender will not necessarily be accepted.
J. B. Fenwick,
Engineer and Manager.
Gas and Water Offices, Grove Street,
Retford, Jan. 5, 1910.

SOUTH METROPOLITAN GAS COMPANY.

NOTICE is Hereby Given, that the ORDINARY HALF-YEARLY GENERAL MEETING of the Proprietors of this Company will be held at De Keyser's Royal Hotel, Victoria Embankment, in the City of London, on Wednesday, the 9th day of February next, at Two o'clock in the Afternoon precisely, to receive the Directors' Report and the Accounts of the Company for the Half Year ended the 31st of December last; to declare a Dividend for the same period; and to elect One Director and One Auditor in the place of those retiring by rotation.
Notice is Hereby also Given, that, immediately after the conclusion of the Business of the Ordinary Meeting, an EXTRAORDINARY GENERAL MEETING will be held to elect a Director in the place of Mr. Edward Henry Cardwell (deceased).
Any Proprietor, duly qualified, intending to become a Candidate for the Vacancy on the Board must give notice in writing at the Office of the Company at least fourteen days previously to the day of Election.
The TRANSFER BOOKS WILL BE CLOSED from the 26th day of January inst. until after the Meeting.
By order,
F. M'Leod,
Secretary.
Offices: 709, Old Kent Road,
London, S.E., Jan. 15, 1910.

EUROPEAN GAS COMPANY LIMITED.

NOTICE is Hereby Given, that an Interim Dividend of Five per Cent. will be paid, free of Income-Tax, on the 1st of February next.
Holders of Share Warrants to Bearer may receive the above—viz: Ten Shillings per Share—on leaving Serial Coupon No. 70 for Examination at the Union of London and Smiths Bank, Limited, 2, Princes Street, London, Three Days previously.
And Notice is Hereby Further Given, that the TRANSFER BOOKS WILL BE CLOSED from the 17th to the 25th inst., both days inclusive.
W. Williams,
Secretary and General Manager.
Finsbury House, Blomfield Street,
London, E.C., Jan. 10, 1910.

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MESSRS. A. & W. RICHARDS beg to notify that their SALES BY AUCTION of NEW CAPITAL ISSUED UNDER PARLIAMENTARY POWERS, and of STOCKS and SHARES belonging to EXECUTORS and other PRIVATE OWNERS in LONDON, SUBURBAN, and PROVINCIAL GAS and WATER COMPANIES, take place PERIODICALLY at the Mart, TOKENHOUSE YARD, E.C.
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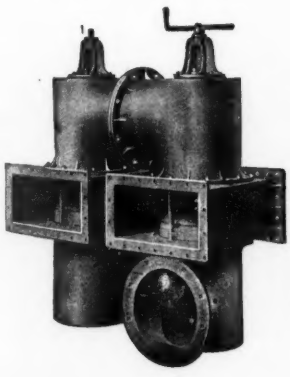

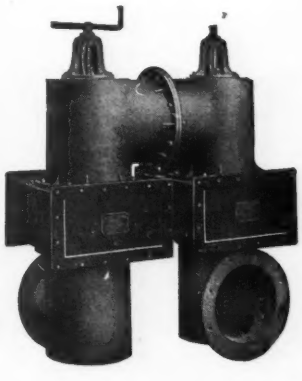

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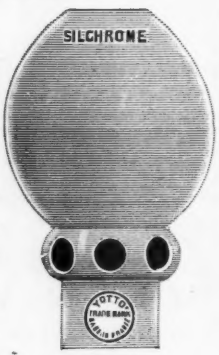

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OPAL COMBINATION.

We are daily receiving repeat orders for this Speciality, and are, therefore, in a position to make the above offer, and will be pleased to give full particulars and prices to Gas Engineers and others interested in Street and Municipal Lighting.

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Fullest particulars on application to—

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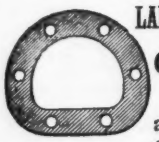

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of GAS-RETORTS,

Horizontal or **Inclined**; also Makers of **Segmental Retorts** of all **Sections.**

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TELEPHONE DUDLEY NO. 10.

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SPECIAL BRICKS & BLOCKS of every description for GENERATOR and REGENERATOR FURNACES.

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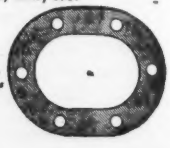


Rheinische Chamotte-und Dinas-Werke, Cologne on Rhine.

Construction of

Entire Gas-Works & Coke Oven Plants,

Retort Furnaces,

Furnaces for Chamber Settings (*Patent*), New Coke Ovens (*Patent*),

With and without Recovery of the Bye-Products, Tar and Benzol Distilleries, Ammonia Works, and Cyanogen Extraction Plants.

GRAETZIN LIGHT

Important Improvements.

BURNERS.

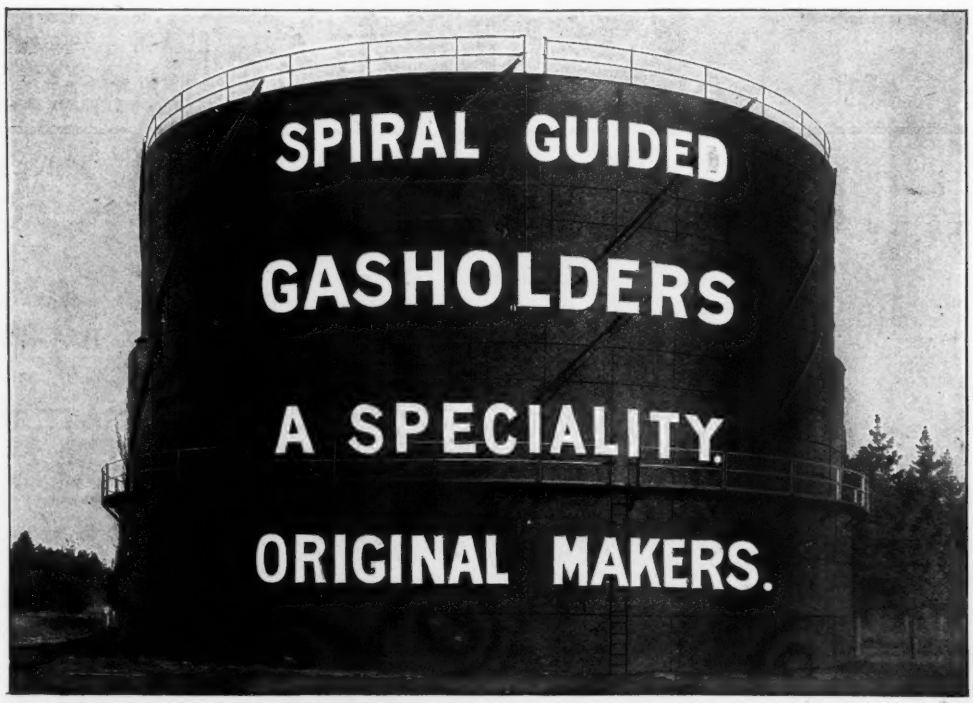
1. **20-Candle Power more light** without increase in the consumption of gas.
2. **Patent Gas Adjuster;** cannot get out of order.
3. **Automatic Gas Regulator,** ensures a constant and unvarying pressure of 35 mm., guarantees a steady light, at the same time obviating waste of gas and blackening of the burner.
4. **Accurate Regulation of the Air Supply.**
5. Burners will be supplied either with Gas Adjuster or Automatic Gas Regulator.
6. The brass casing is heatproof, and, if occasionally cleaned with warm water, will not become discoloured.

LAMPS.

From Lamps with more than one burner, the injectors can be removed from the outside, without taking the lamps to pieces.

CLAYTON, SON & CO., LTD., HUNSLET, LEEDS.

Makers of the First Spiral Guided Holder (1889).



Two-Lift Spiral Guided Gasholder (Clayton and Pickering's Patent Guides) with Steel Tank, capacity 150,500 cubic feet, just completed for the Napier Gas Company, Limited, New Zealand, and erected at their Hastings Works, N.Z.

MAIN LAYING.

Paper by PERCY GRIFFITH, M.Inst.C.E., and BRUCE McGREGOR GRAY, Assoc.M Inst.C.E., before the Association of Water Engineers.

A. The Authors used *Flanged Pipes* for the Rising Main up the Steep side of the Barff, and their experience proved that this was not an advantage, as *the rigidity of the Joints involved considerable difficulty* in regard to the depth of the Trench, and a good deal of Cutting to make the final Connections at each end of the Pipe-Line.

B. In the case of the Delivery Main, the Joints were *Ordinary Socket Joints*, but made with Lead only. The only difficulty met with here was the necessity for *pouring the Lead in* at a suitable temperature *to prevent it melting the Solid Lead Fillet*, and *running through into the Pipe.*

C. In some of the Smaller Branch Connections, Lead Wool was used, and proved highly successful.

Particulars from

THE LEAD WOOL CO., LTD., SNODLAND, KENT.

EVERITT'S Patent

TAR-FOG EXTRACTOR

AND

NAPHTHALENE REMOVER.

SOLE MAKERS:

ROBERT DEMPSTER & SONS,

ROSE MOUNT IRON-WORKS, *LTD.*,

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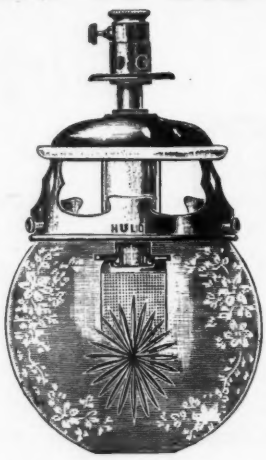
Our "HULO"

INVERTED BURNER

Heavy Quality.



Brilliant Light.

FURTHER IMPROVEMENTS BUT NO INCREASE IN PRICE.

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Gas Engineers,

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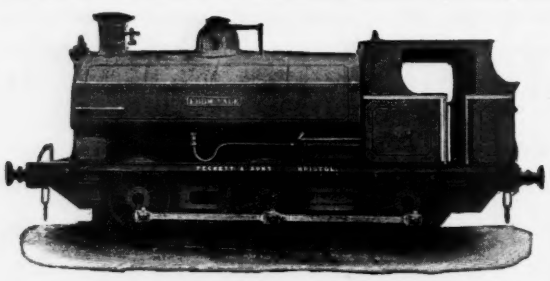

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Specialities:

TRANSMISSION OF POWER.

Rope & Belt Pulleys,
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WORKS:

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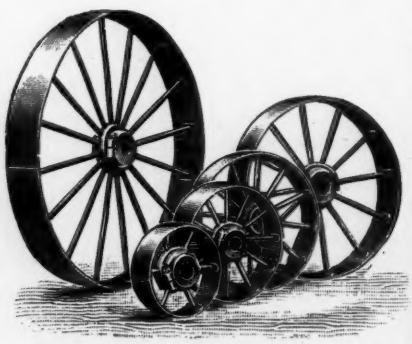
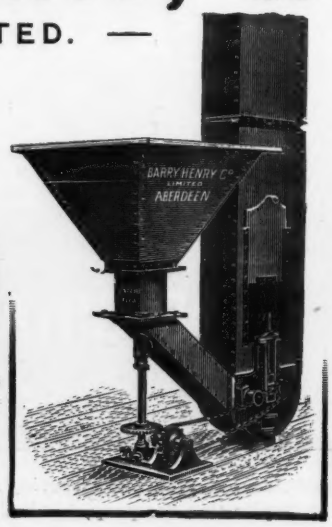
SCOTLAND.





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Conveyors,
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LONDON E.C.

The Inverted Burner has met with great success, but it has by no means

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THE

LUCAS LIGHT'S LONG LIFE

is proof of this.

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The Lucas Light was the first and original self-intensive high-power lamp, and **its steady sale to-day proves its value.**

200, 400, and 700-candle power from a single mantle, with gas at its usual pressure, and with the lowest consumption on record.

No high pressure required.

SIMPLE. BRILLIANT. RELIABLE.

The "Lucas" is the best lamp for Public Halls, Factories, Workshops, Streets, Railway Stations, &c., and the prices compare favourably with those of any similar type of lamp.

WIND, DUST, and INSECT PROOF.

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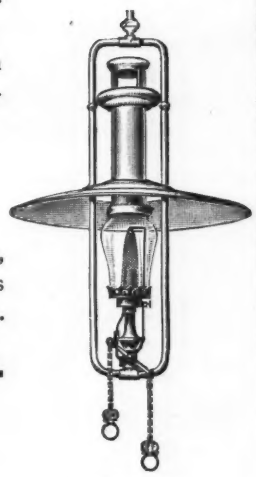

INDOOR.

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PURIFIERS, SCRUBBERS, CONDENSERS, WASHERS, TANKS, VALVES, PIPES, LAMP-PILLARS, RETORT-FITTINGS, ETC.

ALSO ALL KINDS OF

STRUCTURAL IRON AND STEEL WORK.

BRIDGES,

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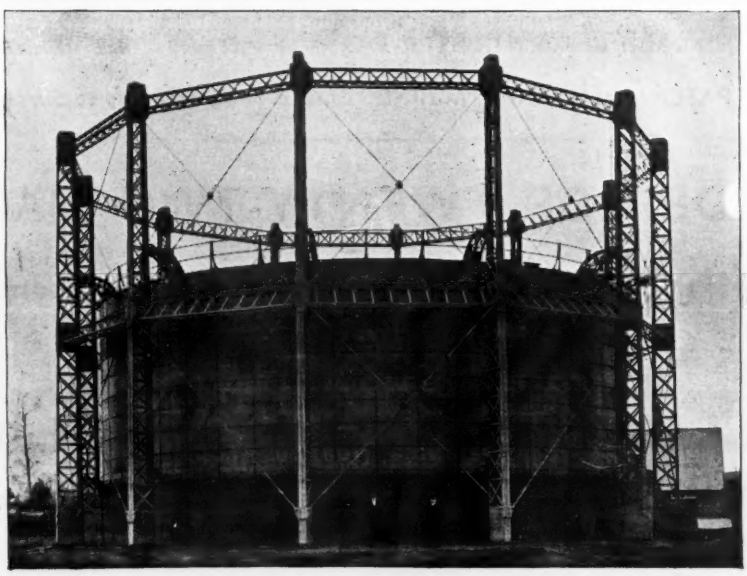

WORKS & HEAD OFFICE:
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STAFFORDSHIRE.

LONDON OFFICE:
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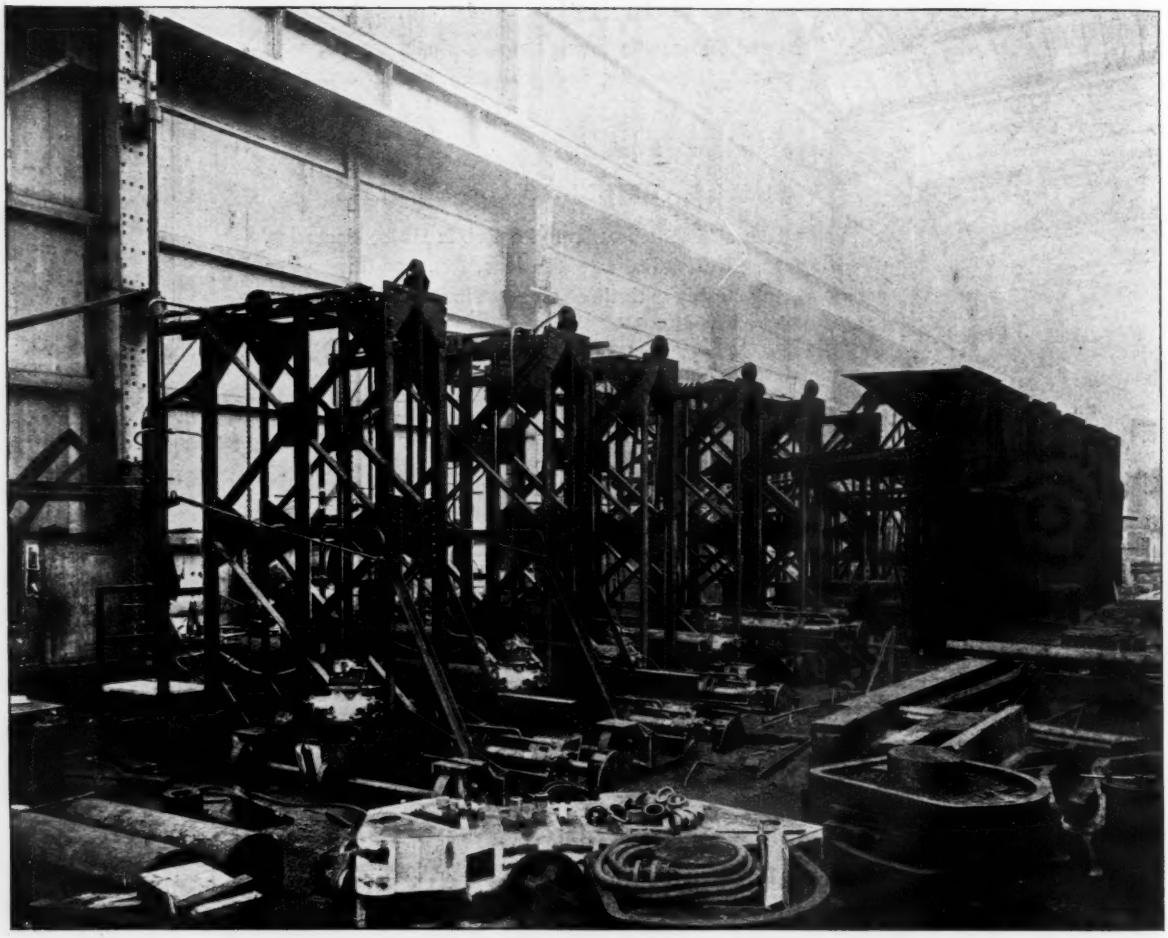
ARROL-FOULIS

PATENT HYDRAULIC MACHINERY

FOR

CHARGING AND DRAWING GAS-RETORTS.



SIX 20 ft. THROUGH RETORT HUNTER-BARNETT PATENT COKE PUSHERS, and

SIX ARROL-FOULIS PATENT CHARGING MACHINES capable of charging up to Six cwt. per Mouthpiece.

PART ORDER OF TWENTY-TWO MACHINES

For the **South Metropolitan Gas Co.,** presently in hand.

SOLE MAKERS:

SIR WILLIAM ARROL & CO., LIMITED,

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FOR FULL PARTICULARS APPLY TO THIS ADDRESS.

Welsbach
LIGHT
Inverted Arc Lamp, Fig. 623.

Storm Proof—
For Exterior Lighting.

Welsbach-Kern
(Patent) Inverted System

BRITISH MADE.

BRITISH MADE.

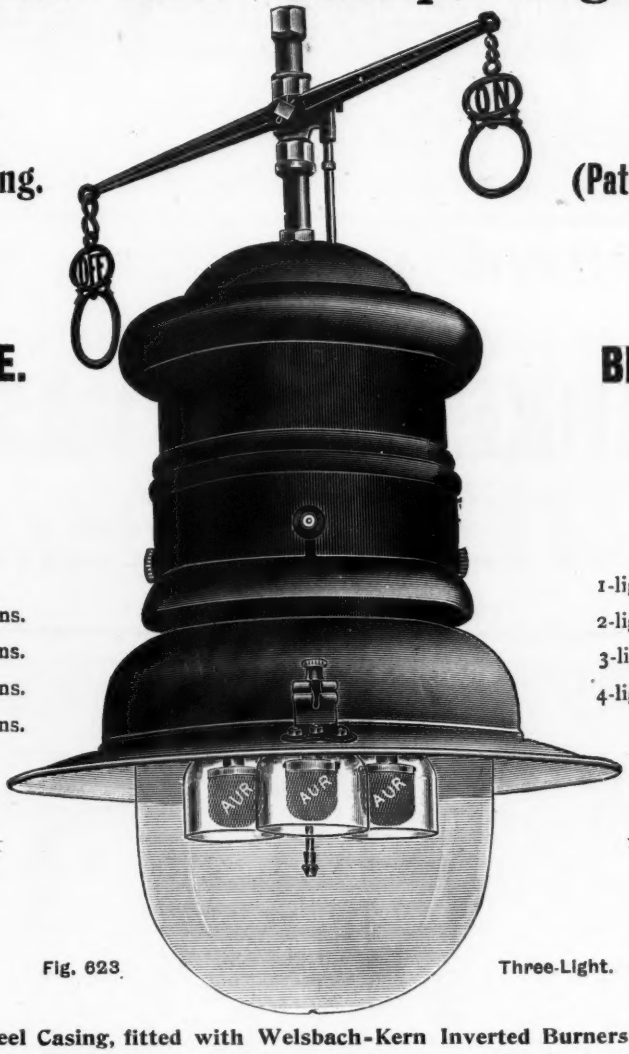


Fig. 623. Three-Light.

Height over all.

1-light . . .	1 ft. 8 ins.
2-light . . .	2 ft. 4 ins.
3-light . . .	2 ft. 4 ins.
4-light . . .	2 ft. 7 ins.

Width over all.

1-light . . .	1 ft. 1 in.
2-light . . .	1 ft. 5 ins.
3-light . . .	1 ft. 5 ins.
4-light . . .	1 ft. 8 ins.

ENAMELLED Green Steel Casing, fitted with Welsbach-Kern Inverted Burners, Gas and Air Regulators operated from outside. Sliding Door to give access to Burners for cleaning purposes. Fitted with Magnesia Nozzles, Welsbach Mantles, and Glass Mantle Protectors. Complete as shown. Highly efficient and regenerative.

	Gas per hour.	*C.P.*	*Steel.*	*Copper Case.*		*Gas per hour.*	*C.P.*	*Steel.*	*Copper Case.*
1-light	4 feet	125	**30/-**	**5/-** extra.	3-light	12 feet	400	**52/6**	**6/-** extra.
2-light	8 feet	260	**47/6**	**6/-** extra.	4-light	16 feet	550	**72/6**	**9/-** extra.

All on or off, or One light on and the rest off, **7/6** per Lamp extra. Cup and Ball, **3/6** per Lamp extra.

RENEWALS.

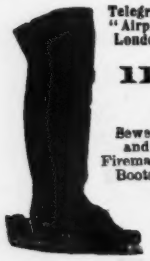
Glass Mantle Protectors (Fig. 623) **3/4½** per dozen, or in case lots of 5 gross, **33/-** per gross.

	1-Light.	*2-Light.*	*3-Light.*	*4-Light.*		*1-Light.*	*2-Light.*	*3-Light.*	*4-Light.*
Clear Glass Globes, each	**2/3**	**5/9**	**5/9**	**9/-**	Wired Globes, extra each	**2/-**	**2/-**	**2/9**	**3/6**
" " " In Case lots per dozen.	**19/6**	**57/9**	**57/9**	**93/-**	Parabolic Reflector, extra "	**3/6**	**6/-**	**7/6**	Not made
Case contains . .	*80*	*18*	*18*	*12*	Welsbach Mantles, each **6d.** subject as usual.				

The Welsbach Mantles for Upright lighting are "C," "CX," and "Plaissetty," price **4½d.** each.

THE WELSBACH INCANDESCENT GAS LIGHT CO., LTD.,
Welsbach House, 344-354, Gray's Inn Road, London, W.C.

Telegrams and Cables: "WELSBACH LONDON." *Telephone 2410 NORTH.*



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Largest Manufacturers of Gas Main Bags.

Sewer and Fireman's Boots.

Gas Bags for repairing Mains. All Seams Stitched and Taped.

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Impervious to Main Liquor and Climatic Influences.

Oilskin Clothing, Diving and Wading Dresses, Sewer Boots, Tar Hose, Stokers' Mitts, Bellows, &c.

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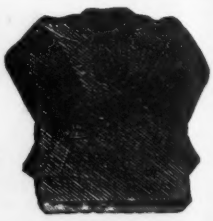
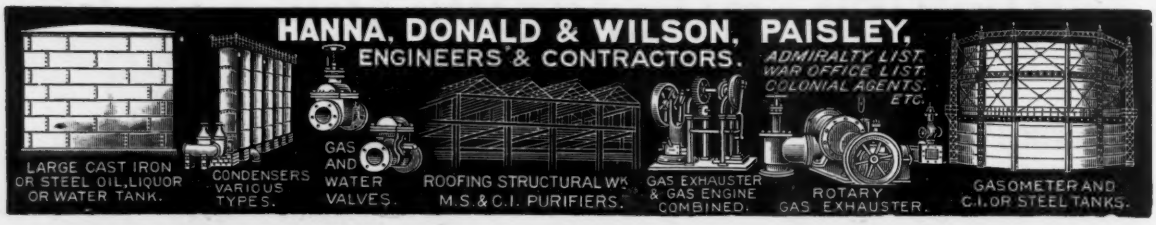


Contractors' and Miners' Jackets.



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ALDWARKE MAIN GAS COAL

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VERY FREE FROM IMPURITIES.

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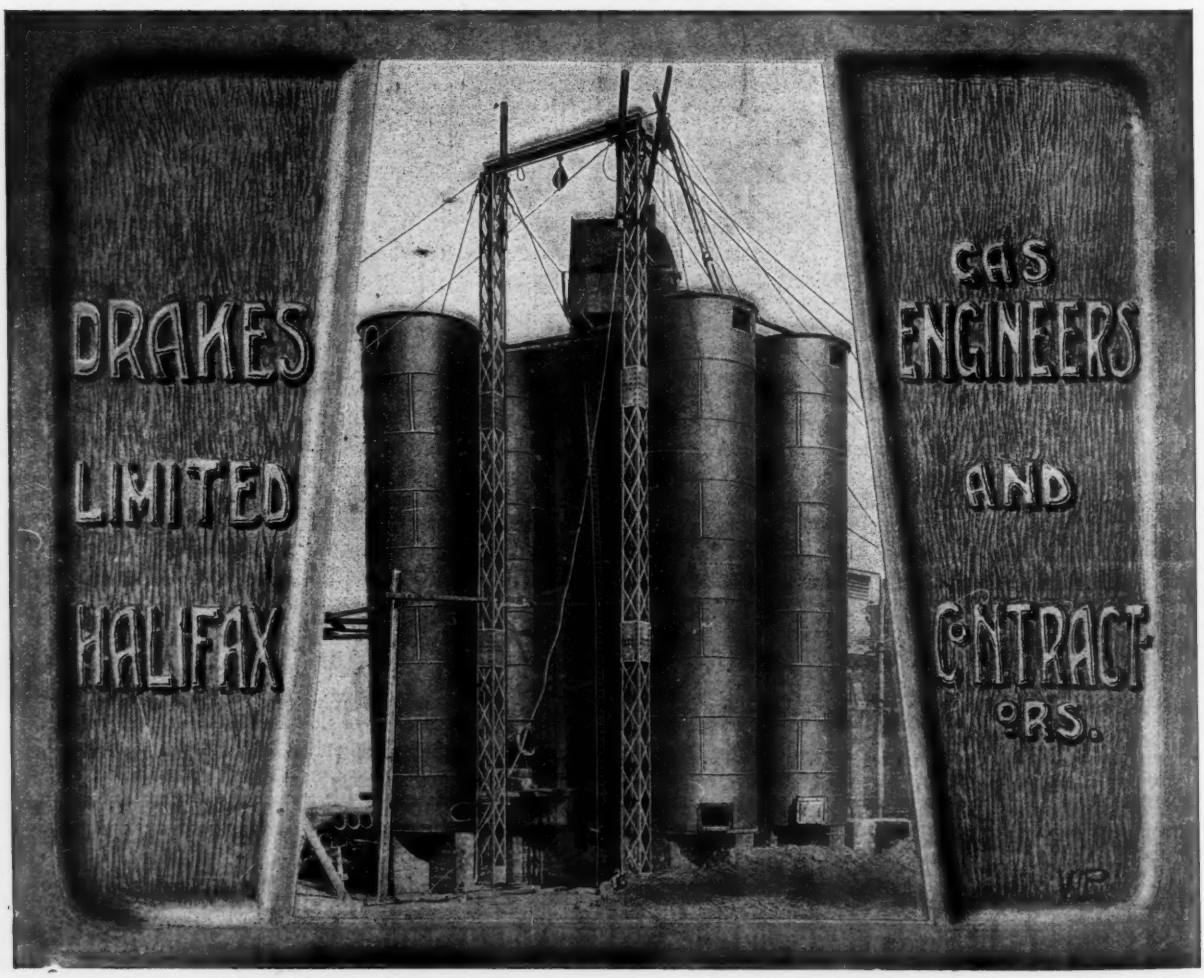

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Employed in the Manufacture of
WELDED STEEL MAINS
for WATERWORKS Etc.

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STOURBRIDGE
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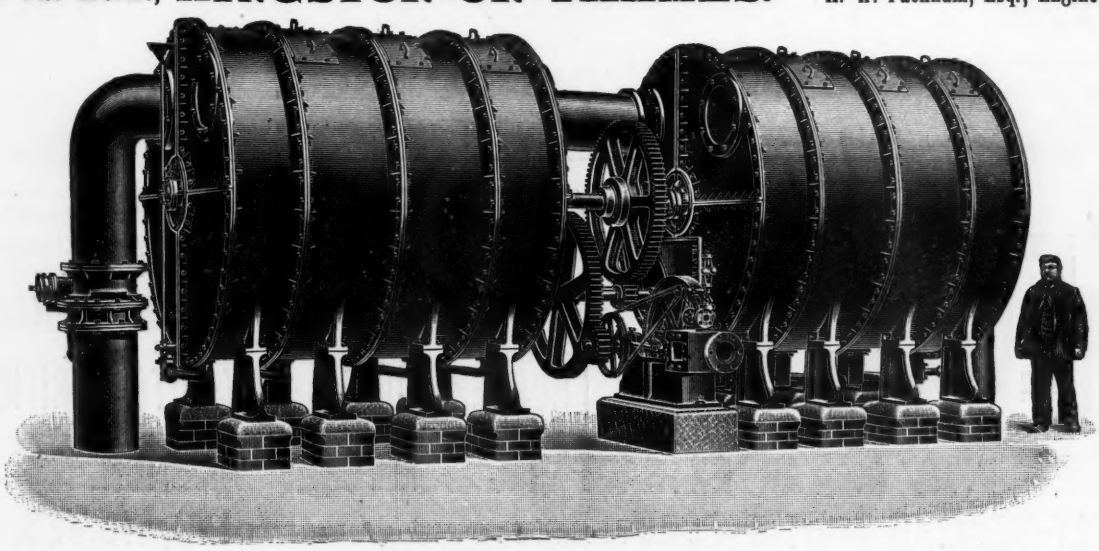
For Gas-Works, **KINGSTON-ON-THAMES.** H. W. Packham, Esq., Engineer.



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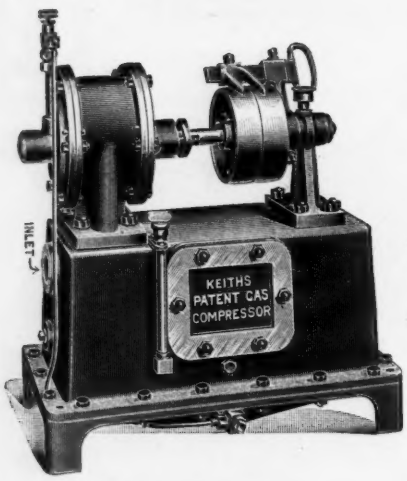

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BALL WASHER SCRUBBER (Laycock and Clapham's Patent).
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RAPID AUTOMATIC FASTENINGS
15,000 Sold, and
RUBBER JOINT FOR DRY-LUTE PURIFIERS
30,550 Feet Sold.

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SELF-SEALING MOUTHPIECES for Inclined & Horizontal Retorts. **MAINS, VALVES, &c.**

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